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# THE NEWS LETTER

OF THE

## BUREAU OF PUBLIC ROADS

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## BUREAU OPPOSED TO PRIVATE TOLL BRIDGES

(NOT FOR RELEASE)

WHILE STATE HIGHWAY DEPARTMENTS, IN THE LAST DECADE, HAVE BEEN TAKING OVER TOLL ROADS AND ABOLISHING THEIR OBJECTIONABLE, TRAFFIC-RETARDING GATES AS RAPIDLY AS POSSIBLE, PRIVATE INTERESTS HAVE BEEN BUSY ACQUIRING EXCLUSIVE RIGHTS TO CONSTRUCT BRIDGES AT COMMANDING LOCATIONS ON THE PUBLIC HIGHWAYS AND SETTING UP NEW GATES, MANY OF WHICH YIELD TO THEIR OWNERS A RATE OF RETURN ON THE CAPITAL INVESTMENT FAR EXCEEDING THAT OF THE MOST PROFITABLE TOLL ROADS.

A SURVEY OF THE SITUATION, JUST COMPLETED BY THE BUREAU, SHOWS THAT THERE WERE 233 TOLL BRIDGES IN OPERATION IN THE UNITED STATES AT THE BEGINNING OF THIS YEAR, 86 OF WHICH WERE BUILT WITHIN THE LAST TEN YEARS; WHICH MEANS THAT THE NUMBER OF SUCH BRIDGES IN OPERATION HAS BEEN INCREASED NEARLY 60 PER CENT IN THE 10-YEAR PERIOD.

HOW RAPIDLY THE NUMBER NOW IN OPERATION IS BEING INCREASED IS SHOWN BY THE FACT THAT THERE ARE AT PRESENT 29 NEW TOLL BRIDGES UNDER CONSTRUCTION, AND 163 PROPOSED FOR CONSTRUCTION. INCLUDED IN THE NUMBER PROPOSED FOR CONSTRUCTION ARE ALL PROJECTED BRIDGES REGARDING WHICH SOME DEFINITE STEP HAS BEEN TAKEN, SUCH AS THE FILING OF AN APPLICATION FOR A FRANCHISE OR THE ORGANIZATION OF A COMPANY TO FINANCE THE CONSTRUCTION. IF ALL THESE BRIDGES NOW UNDER CONSTRUCTION OR PROPOSED ARE COMPLETED, AND NONE OF THE EXISTING BRIDGES IS FREED IN THE MEANTIME, THE NUMBER OF TOLL BRIDGES IN THE UNITED STATES WILL BE NEARLY DOUBLED IN A FEW YEARS.

ONE HUNDRED AND NINETY-ONE OF THE EXISTING 233 BRIDGES ARE PRIVATELY OWNED AND 20 OF THE 29 UNDER CONSTRUCTION ARE BEING BUILT UNDER PRIVATE AUSPICES. THE OTHERS IN EACH CASE ARE PUBLICLY OWNED AND OPERATED - IN MOST CASES WITH THE INTENTION OF LIFTING THE TOLL AS SOON AS THE BRIDGES ARE PAID FOR.

THE LOCATION OF ALL PRIVATELY AND PUBLICLY OWNED TOLL BRIDGES IN THE UNITED STATES IN OPERATION ON OCTOBER 1, 1927, IS SHOWN ON THE ACCOMPANYING MAP. THE MAP ALSO SHOWS THE LOCATION OF THE BRIDGES OF BOTH CLASSES WHICH WERE UNDER CONSTRUCTION OR PROPOSED ON THE SAME DATE.

AS INDICATING THE ATTRACTIVENESS OF SUCH INVESTMENTS FROM THE POINT OF VIEW OF PRIVATE OPERATORS, THE BUREAU CITES THE RETURN ON THE INVESTMENT IN SEVERAL PRIVATELY-OWNED BRIDGES AS REVEALED BY REPORTS OF THE OWNERS.





ONE OF THESE, THE BRIDGE OVER THE POTOMAC RIVER AT WILLIAMS-PORT, MD., WAS BUILT AT A COST OF \$87,000, IN 1907. THE PUBLIC IS STILL PAYING TOLL FOR THE USE OF THE BRIDGE NOTWITHSTANDING THAT IT HAS LONG SINCE PAID FOR ITS CONSTRUCTION. IN 1926 ALONE THE NET OPERATING INCOME, AFTER DEDUCTING ALL COSTS, TAXES, ETC., FROM THE TOLLS RECEIVED, WAS OVER \$41,000, OR 47 PER CENT OF THE ORIGINAL COST, AND A DIVIDEND OF \$32,000 WAS DECLARED, WHICH WAS 32 PER CENT ON THE \$100,000 OF COMMON STOCK.

THE GANDY BRIDGE OVER TAMPA BAY BETWEEN TAMPA AND ST. PETERSBURG, FLA., YIELDED IN 1926, A TOTAL NET INCOME, AFTER DEDUCTION OF ALL EXPENSES INCLUDING DEPRECIATION, OF NEARLY \$211,000 ON AN INVESTMENT IN TANGIBLE PROPERTY OF \$2,158,000. THIS INSTANCE IS, PERHAPS, MORE NEARLY TYPICAL OF THE MAJORITY THAN IS THAT OF THE POLLOCK BRIDGE OVER THE PLATTE RIVER AT PLATTSMOUTH, NEBR., WHICH YIELDED A GROSS INCOME OF MORE THAN 150 PER CENT OF ITS COST ANNUALLY FROM 1923 TO 1925.

THE MAJORITY OF THE TOLL BRIDGES IN THE COUNTRY ARE ON ROADS WHICH ARE PART OF THE FEDERAL-aid HIGHWAY SYSTEM, THE REASON BEING THAT THIS SYSTEM OF 186,000 MILES INCLUDES THE MOST IMPORTANT STATE AND INTERSTATE ROADS WHICH ARE, THEREFORE, THE MOST HEAVILY TRAVELED ROADS IN THE COUNTRY. OF THE 425 TOLL BRIDGES IN OPERATION, UNDER CONSTRUCTION, OR PROPOSED AT THE BEGINNING OF THE YEAR, 217 OR MORE THAN HALF WERE ON THE FEDERAL-aid SYSTEM, 60 WERE ON ROADS INCLUDED IN STATE HIGHWAY SYSTEMS BUT NOT IN THE FEDERAL-aid SYSTEM, AND 148 WERE ON OTHER ROADS.

THE STATE HIGHWAY OFFICIALS OF THE SEVERAL STATES AND OFFICIALS OF THE BUREAU OPPOSE FURTHER CONSTRUCTION OF TOLL BRIDGES FOR OPERATION BY PRIVATE INTERESTS. THEY SAY THAT THE VALUE OF SUCH INVESTMENTS IS CREATED BY THE PUBLIC EXPENDITURES FOR THE IMPROVEMENT OF THE ROADS WHICH LEAD TO THE BRIDGES, AND THEY HAVE INSISTED AT EVERY OPPORTUNITY THAT THE PUBLIC SHOULD NOT BE COMPELLED, INDEFINITELY, TO PAY PROFITS TO PRIVATE BRIDGE OPERATORS LONG AFTER IT HAS PAID IN TOLLS FOR THE BRIDGES CONSTRUCTED. WITH EQUAL INSISTENCE THEY OPPOSE THE COLLECTION OF TOLLS ON PUBLIC BRIDGES EXCEPT AS A MEANS OF FINANCING THEIR COST.

THE HIGHWAY OFFICIALS RECOGNIZE THAT THERE ARE CASES IN WHICH THE FINANCING OF THE COST OF EXPENSIVE BRIDGES BY MEANS OF TOLLS IS THE ONLY PRACTICABLE MEANS; BUT IN SUCH CASES THEY INSIST THAT THE BRIDGES SHOULD BE BUILT AND OPERATED PUBLICLY, AND THAT THE TOLL SHOULD BE COLLECTED ONLY SO LONG AS MAY BE NECESSARY TO PAY THE COSTS OF CONSTRUCTION.





WITH THE PURPOSE OF ENCOURAGING THE ADOPTION OF THIS METHOD, THE OLDFIELD BILL PASSED AT THE LAST SESSION OF CONGRESS, PERMITS THE PAYMENT OF ONE-HALF THE COST OF IMPORTANT BRIDGES ON THE FEDERAL-AID SYSTEM BY THE FEDERAL GOVERNMENT, AND THE FINANCING OF THE OTHER HALF OF THE COST BY THE STATE THROUGH STATE-COLLECTED TOLLS.

EITHER BY TAKING ADVANTAGE OF THE FEDERAL ASSISTANCE THUS OFFERED OR BY CONSTRUCTION AND OPERATION OF NECESSARY TOLL BRIDGES BY THE STATES, COUNTIES AND MUNICIPALITIES, IT IS THE BELIEF OF MR. MACDONALD, CHIEF OF THE BUREAU, THAT THERE CAN BE SAVED TO THE TRAVELING PUBLIC, A VERY LARGE AMOUNT OF MONEY WHICH IS NOW TAKEN BY PRIVATE OPERATORS AS PROFIT ON INVESTMENTS, THE PROFITABLE CHARACTER OF WHICH DERIVES FROM THE PUBLIC EXPENDITURES FOR ROAD IMPROVEMENT. MR. MACDONALD STATES THAT THE PUBLIC CAN BORROW MONEY ON TERMS AT LEAST AS FAVORABLE AS THOSE AVAILABLE TO PRIVATE BUILDERS, AND USUALLY ON BETTER TERMS. HE IS CONVINCED THAT THE EXISTING PUBLIC AGENCIES CAN ERECT AND OPERATE THE BRIDGES AS EFFICIENTLY AND ECONOMICALLY AS THE PRIVATE OWNERS; AND, IF THE TOLLS ARE ABOLISHED WHEN THE BRIDGES ARE PAID FOR, THE TRAVELING PUBLIC WILL BE SAVED THE PAYMENT OF THE HANDSOME PROFITS WHICH ARE THE INDUCEMENT THAT IS RESPONSIBLE FOR THE INCREASING PRIVATE INTEREST IN TOLL-BRIDGE CONSTRUCTION.

IN THIS CONNECTION, MR. MACDONALD POINTS OUT THAT THE BORROWING OF MONEY BY PUBLIC AGENCIES FOR BRIDGE CONSTRUCTION NO LONGER NEED ENTAIL AN INCREASE OF PROPERTY TAXATION TO PROVIDE FOR SINKING FUND AND INTEREST. THERE IS AN ACTIVE MARKET FOR REVENUE BONDS WHICH ARE SECURED AND RETIRED WITH NO OTHER FUNDS THAN THE REVENUES DERIVED FROM THE TOLLS COLLECTED. BY RESORTING TO THIS METHOD OF FINANCING, COSTLY BRIDGES CAN BE BUILT BY THE PUBLIC WITHOUT INCREASING TAXES, AND CAN BE PAID FOR BY THOSE WHO USE THEM WITHOUT PAYING SEVERAL TIMES THEIR COST IN PROFITS.

IF THE BRIDGES ARE BUILT BY PUBLIC AGENCIES THERE IS ALSO THE ASSURANCE OF OPEN COMPETITION AND THE AWARDED OF THE CONTRACT TO THE LOWEST RESPONSIBLE BIDDER, A CONDITION THAT HAS BEEN NOTICEABLY LACKING IN MUCH OF THE PRIVATE CONSTRUCTION UPON WHICH THE PUBLIC IS ASKED TO PAY DIVIDENDS IN THE FORM OF TOLLS.

THERE IS SOME INDICATION OF A GROWING APPRECIATION OF THE WISDOM OF PUBLIC OPERATION IN THE FACT THAT 63 OF THE 163 NEW BRIDGES PROPOSED AT THE BEGINNING OF THE YEAR WILL BE PUBLICLY OWNED AND OPERATED. THIS IS A CONSIDERABLY LARGER PROPORTION THAN IS FOUND AMONG THE BRIDGES NOW IN OPERATION AND UNDER CONSTRUCTION. THAT THERE IS STILL A VERY ACTIVE PRIVATE INTEREST, HOWEVER, IS INDICATED BY THE FACT THAT 33 BILLS, EACH AUTHORIZING THE CONSTRUCTION OF A PARTICULAR PRIVATE TOLL BRIDGE, HAVE BEEN PASSED BY THE HOUSE SINCE CONGRESS CONVENED IN DECEMBER.



WHENEVER IT IS AT ALL POSSIBLE TO DO SO, MR. MACDONALD TAKES THE POSITION THAT NECESSARY BRIDGES SHOULD BE FINANCED WITHOUT TOLL COLLECTION. IN SUPPORT OF THIS POSITION HE POINTS TO THE FACT REVEALED BY AN INVESTIGATION BY THE STATE HIGHWAY COMMISSION OF WASHINGTON THAT THE MERE COST OF COLLECTING THE TOLLS AMOUNTS TO FROM 15 TO 27 PER CENT OF THE TOLLS COLLECTED. THE REPORT OF THIS INVESTIGATION, WHICH WAS AUTHORIZED BY THE WASHINGTON LEGISLATURE, FURTHER SHOWS THAT THE COST OF SERVICE ON ALL TOLL BRIDGES ON THE HIGHWAY SYSTEM OF THE STATE IS FROM 63 TO 185 PER CENT HIGHER THAN SIMILAR SERVICE WOULD HAVE COST IF THE BRIDGES HAD BEEN FREE.

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#### LYNCH TO BE IN CHARGE OF DISTRICT I

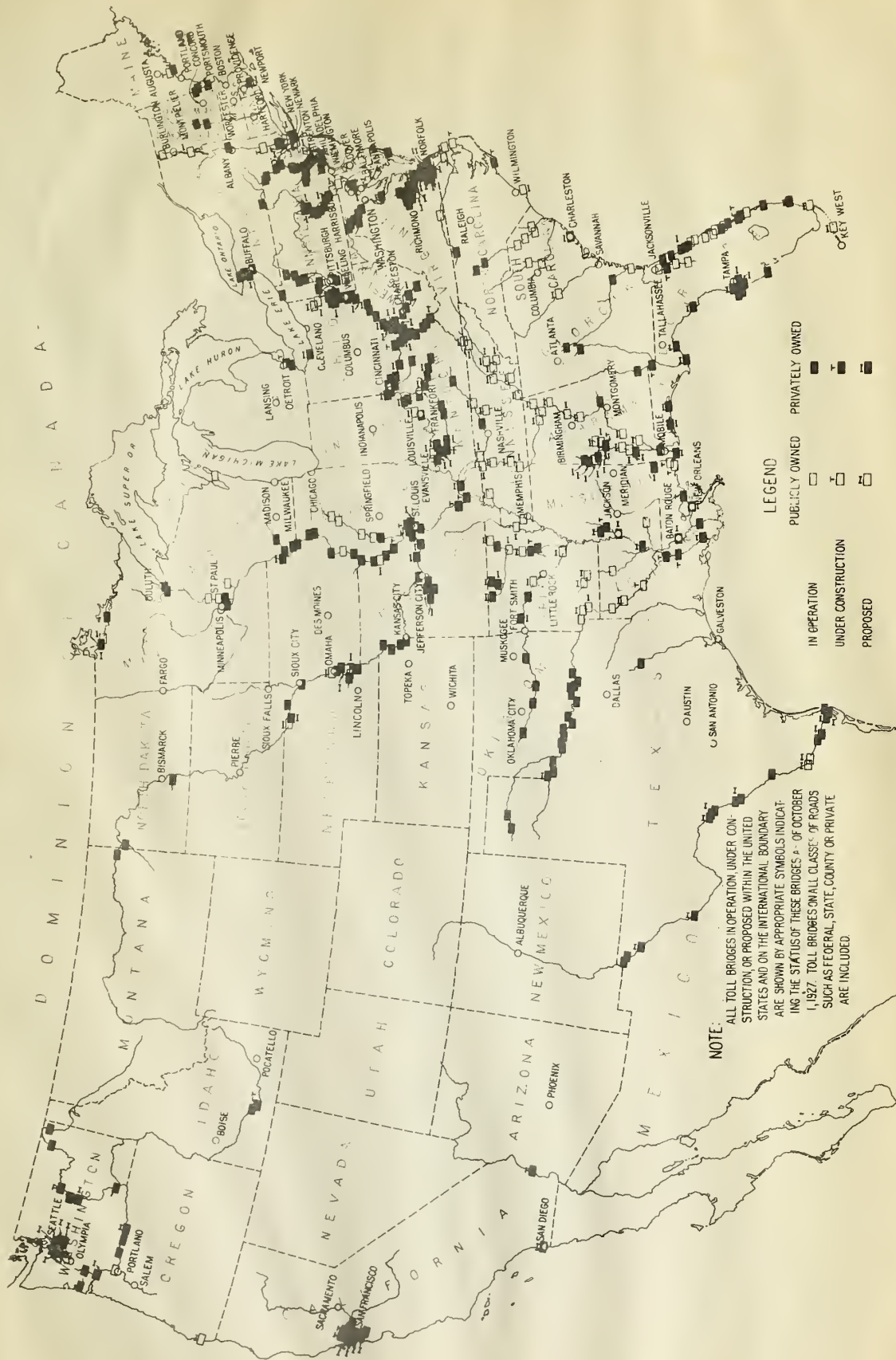
W. H. LYNCH, FORMERLY DISTRICT ENGINEER OF DISTRICT 5, WITH HEADQUARTERS AT OMAHA, WILL BECOME DISTRICT ENGINEER OF DISTRICT I, WITH HEADQUARTERS AT PORTLAND, ORE., FILLING THE VACANCY CAUSED BY THE RESIGNATION OF MR. PURCELL, WHOSE APPOINTMENT AS STATE HIGHWAY ENGINEER OF CALIFORNIA BECAME EFFECTIVE ON FEBRUARY 15.

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#### R. W. CRUM APPOINTED DIRECTOR OF HIGHWAY RESEARCH BOARD

R. W. CRUM, FORMERLY MATERIALS AND TESTS ENGINEER OF THE IOWA STATE HIGHWAY COMMISSION, HAS ACCEPTED THE DIRECTORSHIP OF THE HIGHWAY RESEARCH BOARD, EFFECTIVE MARCH 1; TAKING OVER THE DUTIES FORMERLY PERFORMED BY MR. UPHAM, WHO RESIGNED, EARLIER IN THE YEAR, TO DEVOTE HIS ENTIRE TIME TO THE ACTIVITIES OF THE AMERICAN ROAD BUILDERS' ASSOCIATION.











## ADVANTAGES OF PROPORTIONING CONCRETE AGGREGATES BY WEIGHT

CONTRIBUTED BY F. H. JACKSON OF THE DIVISION OF TESTS

(NOT FOR RELEASE)

IN VIEW OF THE INCREASING INTEREST WHICH IS BEING SHOWN BY HIGHWAY ENGINEERS IN THE MATTER OF MEASURING AGGREGATES FOR CONCRETE BY WEIGHT, INSTEAD OF BY LOOSE VOLUME; IT MAY BE OF VALUE AT THIS TIME TO DISCUSS BRIEFLY SOME OF THE ADVANTAGES OF THIS SYSTEM, AS WELL AS TO POINT OUT SOME OF THE PRECAUTIONS WHICH MUST BE OBSERVED WHEN SPECIFYING AGGREGATES BY WEIGHT, IN ORDER THAT THE MAXIMUM BENEFITS MAY BE DERIVED.

R. W. CRUM, ENGINEER OF MATERIALS AND TESTS FOR THE IOWA STATE HIGHWAY COMMISSION WAS ONE OF THE FIRST STATE HIGHWAY OFFICIALS TO ADVOCATE THE MEASUREMENT OF CONCRETE AGGREGATES BY WEIGHT. IT WAS FIRST TRIED OUT ON AN ACTUAL PAVING PROJECT IN IOWA, IN 1923, WITH SUCH SUCCESSFUL RESULTS THAT IT WAS ADOPTED AS STANDARD PRACTICE IN THE FOLLOWING YEAR, AND HAS BEEN USED EXCLUSIVELY EVER SINCE. AT THE PRESENT TIME IT IS SPECIFIED AS THE STANDARD METHOD IN SOUTH CAROLINA, AND AS AN ALTERNATE METHOD IN A NUMBER OF OTHER STATES.

THE OUTSTANDING ADVANTAGES TO BE DERIVED FROM THE MEASUREMENT OF AGGREGATES BY WEIGHT ARE AS FOLLOWS:

1. - IT AUTOMATICALLY CORRECTS FOR THE SO-CALLED "BULKING ACTION" OF MOISTURE IN SAND.
2. - IT MAKES POSSIBLE A MUCH MORE ACCURATE ESTIMATE OF THE QUANTITIES OF MATERIALS REQUIRED FOR A GIVEN AMOUNT OF CONCRETE.
3. - IT FURNISHES A RECORD OF THE WEIGHTS OF MATERIALS USED ON THE JOB, WHICH MAY BE OF VALUE TO THE CONTRACTOR AS A CHECK AGAINST CAR WEIGHTS.

ALL CONCRETE ENGINEERS ARE FAMILIAR WITH THE FACT THAT WHEN MOISTURE IS ADDED TO A DRY SAND IT SWELLS OR BULKS TO AN APPRECIABLE EXTENT, SO THAT A GIVEN VOLUME WILL NOT CONTAIN AS MUCH ACTUAL MATERIAL AS IF THE SAND WERE DRY. THIS BULKING IN THE ORDINARY CONCRETE SAND WILL AMOUNT TO AS MUCH AS 25 OR 30 PER CENT OF THE ORIGINAL VOLUME OF THE DRY SAND FOR MOISTURE CONTENTS OF FROM 3 TO 5 PER CENT, WHICH IS THE AVERAGE STOCK-PILE CONDITION. IN OTHER WORDS, ASSUMING THE CONVENTIONAL VOLUMETRIC METHOD OF MEASUREMENT, THE ACTUAL AMOUNT OF SAND IN A GIVEN BATCH WILL VARY FROM A MAXIMUM WHEN THE SAND IS DRY TO A MINIMUM WHEN THE SAND IS IN THE AVERAGE



STOCK-PILE CONDITION; THAT IS, CONTAINING FROM 3 TO 5 PER CENT MOISTURE. FROM THIS POINT, ADDITIONS OF WATER CAUSE A GRADUAL INCREASE IN THE QUANTITY OF SAND UNTIL A POINT IS REACHED WHEN THE SAND BECOMES SATURATED WITH WATER, THAT IS, THE VOIDS ARE COMPLETELY FILLED, IN WHICH STATE A GIVEN QUANTITY OF SAND OCCUPIES ESSENTIALLY THE SAME VOLUME AS IF IT WERE DRY. MEASUREMENT OF SAND IN THIS CONDITION IS KNOWN AS "INUNDATION." IT IS OBVIOUS THAT DUE TO THIS TENDENCY TO "BULK" IT IS IMPOSSIBLE TO INSURE EITHER A CONSTANT QUALITY OR A CONSTANT QUANTITY OF CONCRETE. IN THE FIRST PLACE, VARIATIONS IN THE QUANTITY OF SAND IN THE BATCH WILL AFFECT ITS CONSISTENCY AND THEREFORE THE AMOUNT OF WATER REQUIRED FOR A WORKABLE MIXTURE. THIS IN TURN WILL, OF COURSE, AFFECT THE STRENGTH OF THE CONCRETE. IN THE SECOND PLACE, THE QUANTITY OF CONCRETE PRODUCED WILL VARY DIRECTLY WITH VARIATIONS IN THE ABSOLUTE VOLUME OF THE SAND EVEN THOUGH APPARENTLY THE SAME AMOUNT OF SAND IS BEING MEASURED OUT.

WHEN, HOWEVER, THE DESIRED QUANTITY OF SAND IS WEIGHED, THE SAME ABSOLUTE VOLUME IS BEING DELIVERED, REGARDLESS OF THE MOISTURE CONTENT, JUST AS LONG THE SPECIFIC GRAVITY OF THE SAND REMAINS CONSTANT. THE ONLY ERROR INTRODUCED BY THIS METHOD IS DUE TO THE ACTUAL WEIGHT OF THE WATER PRESENT, WHICH IS OF COURSE VERY SMALL IN TERMS OF THE WEIGHT OF THE SAND. EVEN THIS ERROR, HOWEVER, CAN BE ELIMINATED BY MAKING A MOISTURE DETERMINATION ON THE SAND, AND CORRECTING THE WEIGHT ACCORDINGLY.

#### YIELD AFFECTED BY VARIATIONS IN THE COARSE AGGREGATE

ALTHOUGH COARSE AGGREGATES TO A VERY LIMITED EXTENT EXHIBIT THE BULKING EFFECT REFERRED TO ABOVE, THE AMOUNT IS USUALLY SO SMALL AS TO BE WITHOUT PRACTICAL SIGNIFICANCE, SO THAT SO FAR AS THIS FEATURE IS CONCERNED SATISFACTORY RESULTS MAY BE OBTAINED WITH EITHER METHOD OF MEASUREMENT.

VARIATIONS IN THE YIELD OF CONCRETE DUE TO CHANGES IN GRADATION OF THE COARSE AGGREGATE MAY, HOWEVER, BE QUITE MARKED WHEN THE MATERIALS ARE MEASURED BY VOLUME. MEASUREMENT OF THE COARSE AGGREGATE BY WEIGHT, ON THE OTHER HAND, INSURES THE SAME ABSOLUTE VOLUME OF MATERIAL FROM BATCH TO BATCH, IRRESPECTIVE OF ITS GRADING OR VOID CONTENT, JUST AS LONG AS ITS SPECIFIC GRAVITY REMAINS CONSTANT. THIS, AS NOTED ABOVE, MAKES POSSIBLE A MUCH CLOSER ESTIMATION OF THE QUANTITIES OF MATERIALS WHICH WILL BE REQUIRED THAN UNDER THE OLD METHOD.





IT MUST NOT BE INFERRED, HOWEVER, THAT THE GRADING OF THE AGGREGATES CAN BE IGNORED WHEN MEASUREMENTS ARE MADE BY WEIGHT. ALTHOUGH, AS HAS JUST BEEN STATED, THE YIELD WILL BE CONSTANT INsofar AS IT IS AFFECTED BY VARIATIONS IN THE ABSOLUTE VOLUME OF AGGREGATES, CHANGES IN GRADATION MATERIALLY AFFECT THE AMOUNT OF WATER NECESSARY TO SECURE A GIVEN WORKABILITY. THE FINER THE GRADING OF A GIVEN AGGREGATE, THE GREATER IN GENERAL WILL BE THE AMOUNT OF WATER REQUIRED. THIS FLUCTUATION IN WATER CONTENT WILL IN ITSELF CAUSE A VARIATION IN YIELD, SINCE THE VOLUME OF CONCRETE WILL IN ANY CASE (FOR PLASTIC MIXTURES) BE EQUAL TO THE SUM OF THE ABSOLUTE VOLUMES OF THE CEMENT, AGGREGATES AND WATER. THIS IS AN AFFECT WHICH PERSISTS IRRESPECTIVE OF THE METHOD OF AGGREGATE MEASUREMENT USED AND ACCOUNTS IN A GREAT MANY CASES FOR THE DIFFICULTIES EXPERIENCED BY MIXER OPERATORS IN MAINTAINING SIMULTANEOUSLY A UNIFORM WATER CONTENT AND A UNIFORM CONSISTENCY.

THE ONLY WAY TO OVERCOME THIS DIFFICULTY IS TO CONTROL THE GRADING OF THE COARSE AGGREGATE MORE CAREFULLY THAN HAS BEEN THE PRACTICE IN THE PAST. THIS HAS RECENTLY BEEN ACCOMPLISHED IN NORTH CAROLINA BY USING THREE SEPARATE SIZES OF COARSE AGGREGATE AND MEASURING DEFINITE QUANTITIES OF EACH, TOGETHER WITH DEFINITE QUANTITIES OF SAND, CEMENT, AND WATER. IN THIS WAY, AND IN THIS WAY ONLY, CAN THE GRADATION OF THE COARSE AGGREGATE BE CONTROLLED WITHIN THE NARROW LIMITS NECESSARY IF UNIFORM CONCRETE IS TO BE OBTAINED.

A FACT WHICH MUST NOT BE OVERLOOKED IN CONNECTION WITH THE WEIGHING OF AGGREGATES IS THE EFFECT OF VARIATIONS IN THE SPECIFIC GRAVITY OF THE AGGREGATE ON THE YIELD OF CONCRETE OBTAINED. IN THE MATTER OF THE MEASUREMENT OF AGGREGATES FOR CONCRETE, WHAT WE ARE INTERESTED IN FROM THE STANDPOINT OF YIELD IS A PROCEDURE WHICH WILL INSURE THE DELIVERY OF THE SAME ABSOLUTE VOLUMES OF AGGREGATES IRRESPECTIVE OF THEIR SPECIFIC GRAVITIES. JUST AS LONG AS THE SPECIFIC GRAVITY REMAINS THE SAME, THE ABSOLUTE VOLUMES WILL, OF COURSE, BE PROPORTIONAL TO THE WEIGHT. ANY CHANGE IN THE SPECIFIC GRAVITY, HOWEVER, WILL DISTURB THIS RELATION; THE MATERIAL WITH THE HIGHER GRAVITY HAVING A SMALLER ABSOLUTE VOLUME FOR A GIVEN WEIGHT THAN THE MATERIAL WITH THE LOWER GRAVITY. ON THE BASIS OF EQUAL WEIGHTS SPECIFIED, THIS WOULD OF COURSE RESULT IN A GREATER YIELD OF CONCRETE WHEN THE MATERIAL HAVING THE LOWER SPECIFIC GRAVITY WAS USED. IT IS CONCEIVABLE THAT A SITUATION MIGHT DEVELOP WHICH WOULD MAKE IT TO THE INTEREST OF THE CONTRACTOR TO SECURE THE LIGHTEST MATERIAL HE COULD POSSIBLY FIND WHICH WOULD MEET THE SPECIFICATIONS, IN ORDER TO INCREASE THE YIELD.





## INFLUENCE OF SPECIFIC GRAVITY OF AGGREGATE ON YIELD

THE INFLUENCE OF THE SPECIFIC GRAVITY OF THE COARSE AGGREGATE ON THE YIELD OF CONCRETE WHEN THE AGGREGATES ARE MEASURED BY WEIGHT MAY BE BEST ILLUSTRATED BY MEANS OF AN EXAMPLE. LET US SUPPOSE THAT A WEIGHT PROPORTION IN POUNDS IS STATED AS FOLLOWS:

$$94 : 180 : 364.$$

THIS WOULD BE EQUIVALENT TO A 1:2:4 VOLUMETRIC MIX, ASSUMING THE SAND TO WEIGH 90 POUNDS PER CUBIC FOOT AND THE CRUSHED STONE TO WEIGH 91 POUNDS PER CUBIC FOOT. FOR LIMESTONE HAVING A SPECIFIC GRAVITY OF 2.65, THE ABSOLUTE VOLUME OF STONE IN A 1-BAG BATCH OF CONCRETE WOULD BE,

$$\frac{364}{2.65 \times 62.4} = 2.2 \text{ CUBIC FEET.}$$

FOR A TRAP ROCK AGGREGATE WITH A SPECIFIC GRAVITY OF 3.00, THE ABSOLUTE VOLUME WOULD BE,

$$\frac{364}{3.00 \times 62.4} = 1.94 \text{ CUBIC FEET.}$$

OTHER THINGS BEING EQUAL, THE DIFFERENCE IN YIELD WOULD THEN BE

$$2.2 - 1.94 = .26 \text{ CUBIC FEET PER BAG OF CEMENT,}$$

OR ABOUT  $1\frac{1}{2}$  CUBIC FEET FOR EACH 6-BAG BATCH.

IN ORDER TO CORRECT FOR THIS SITUATION, IT IS NECESSARY TO SO PROPORTION THE WEIGHTS OF LIMESTONE AND TRAP ROCK AS TO GIVE THE SAME ABSOLUTE VOLUME IN BOTH CASES. ASSUMING, FOR INSTANCE, THAT IT IS DESIRED TO OBTAIN A YIELD EQUIVALENT TO AN ABSOLUTE VOLUME OF 2.20 (THAT GIVEN BY THE LIMESTONE AGGREGATE) THE FOLLOWING CALCULATION WILL GIVE THE WEIGHT OF TRAP ROCK REQUIRED TO PRODUCE THIS ABSOLUTE VOLUME:

$$3.00 \times 62.4 \times 2.2 = 412 \text{ POUNDS.}$$

ON THE BASIS OF 45 PER CENT VOIDS IN THE STONE, THIS WOULD BE THE WEIGHT OF TRAP ROCK WHICH WOULD HAVE BEEN OBTAINED IF THE ORIGINAL 1:2:4 VOLUMETRIC METHOD OF MEASUREMENT HAD BEEN EMPLOYED.

LET US NOW ASSUME A CASE WHERE THE GRADATION, AND THEREFORE THE VOID CONTENT OF THE LIMESTONE, CHANGES. IN THE ABOVE EXAMPLE, THE VOID CONTENT IS 45 PER CENT. A CHANGE TO 50 PER CENT VOIDS WILL NOT CHANGE THE ABSOLUTE VOLUME OF LIMESTONE AT ALL AS LONG



AS THE WEIGHT REMAINS AT 364 POUNDS. THE YIELD OF CONCRETE WILL THEREFORE NOT BE CHANGED. THE APPARENT VOLUME OF THE COARSE AGGREGATE WILL, HOWEVER, BE INCREASED FROM 4 CUBIC FEET TO 4.4 CUBIC FEET. MEASUREMENT BY WEIGHT, THEREFORE, INCREASES THE APPARENT VOLUME OF AGGREGATE USED AS THE PERCENTAGE OF VOIDS INCREASES.

ON THE OTHER HAND, IF THE STONE WERE MEASURED BY VOLUME, A CHANGE OF FROM 45 TO 50 PER CENT IN VOIDS WOULD CHANGE THE ABSOLUTE VOLUME OF THE COARSE AGGREGATE TO

$$(1.00 - 0.50) \times 4.0 = 2.0 \text{ CUBIC FEET}$$

AND THE YIELD WOULD BE REDUCED 0.2 CUBIC FOOT PER BAG OF CEMENT, OR 1.2 CUBIC FEET FOR EACH 6-BAG BATCH.

AS A FINAL EXAMPLE, LET US ALSO ASSUME THAT, IN ADDITION TO THE LIMESTONE AND TRAP ROCK WE HAVE A GRAVEL AGGREGATE AVAILABLE WITH A SPECIFIC GRAVITY OF 2.65. IN THE PREVIOUS EXAMPLE WE ASSUMED A GRADING WHICH WOULD GIVE ABOUT 45 PER CENT VOIDS IN THE STONE. A CORRESPONDING GRADING IN THE CASE OF GRAVEL WOULD GIVE ABOUT 38 PER CENT VOIDS, THE DIFFERENCE BEING DUE TO THE GREATER COMPACTION AFFORDED BY THE ROUNDED FRAGMENTS. FOR THIS CONDITION THE ABSOLUTE VOLUME OF GRAVEL IN A 1-BAG BATCH OF CONCRETE, FOR A WEIGHT OF 364 POUNDS WOULD BE

$$\frac{364}{2.65 \times 62.4} = 2.2 \text{ CUBIC FEET,}$$

OR EXACTLY THE SAME AS THE LIMESTONE, BECAUSE THE SPECIFIC GRAVITIES ARE THE SAME. IF HOWEVER, THE CONVENTIONAL VOLUMETRIC MEASUREMENT IS USED, WE WOULD HAVE 4 CUBIC FEET OF GRAVEL, BY VOLUME, WHICH FOR A VOID CONTENT OF .38 PER CENT WOULD GIVE AN ABSOLUTE VOLUME OF

$$(1.00 - 0.38 \times 4 = 2.48 \text{ CUBIC FEET}$$

PER BAG OF CEMENT, OR 0.28 CUBIC FEET MORE THAN THE LIMESTONE WITH THE SAME GRADING AND SPECIFIC GRAVITY. THIS WOULD OF COURSE RESULT, OTHER THINGS BEING EQUAL, IN AN INCREASE IN YIELD OF 0.28 CUBIC FEET PER BAG OF CEMENT FOR THE GRAVEL CONCRETE.

THESE EXAMPLES ARE GIVEN MERELY TO ILLUSTRATE CERTAIN FUNDAMENTAL PRINCIPLES WHICH MUST BE UNDERSTOOD BEFORE THE METHOD OF MEASURING COARSE AGGREGATES BY WEIGHT CAN BE INTELLIGENTLY APPLIED, WHICH ARE:



1. - THAT WHEN PROPORTIONS ARE BY VOLUME, VARIATIONS IN THE VOID CONTENT OF THE AGGREGATE AFFECT THE YIELD, WHEREAS VARIATIONS IN THE SPECIFIC GRAVITY DO NOT AFFECT THE YIELD.

2. - THAT WHEN PROPORTIONS ARE BY WEIGHT, VARIATIONS IN VOID CONTENT DO NOT AFFECT THE YIELD, BUT VARIATIONS IN THE SPECIFIC GRAVITY DO AFFECT THE YIELD.

## HOW TO CHANGE OVER FROM VOLUMETRIC TO WEIGHT MEASUREMENT

UNLESS AN EFFORT IS TO BE MADE TO DESIGN CONCRETE FOR A GIVEN STRENGTH IN ACCORDANCE WITH ONE OF THE THEORIES WHICH HAVE BEEN PROPOSED, IT WILL PROBABLY BE NECESSARY IN MOST CASES FOR THE STATE HIGHWAY DEPARTMENTS WHICH DESIRE TO CHANGE OVER TO A WEIGHT BASIS OF MEASUREMENT TO SIMPLY CONVERT THEIR PRESENT VOLUMETRIC PROPORTIONS INTO EQUIVALENT WEIGHTS. IN DOING THIS, IT WILL BE NECESSARY TO ASSUME, FOR PURPOSES OF CALCULATION, A VOID CONTENT WHICH MOST NEARLY APPROXIMATES THE AVERAGE VOID CONTENT OF THE AGGREGATES UNDER THE OLD SPECIFICATION. IT WILL FURTHER BE NECESSARY TO PROVIDE FOR DIFFERENT WEIGHTS OF AGGREGATE TO USE WHERE MATERIALS OF VARYING SPECIFIC GRAVITY ARE ENCOUNTERED.

## PROPORTIONING GRAVEL AND STONE BY WEIGHT

IN ADDITION TO THE ABOVE, IT WILL BE NECESSARY WHEN DEALING WITH BOTH GRAVEL AND CRUSHED STONE TO CONSIDER THE EFFECT OF THE RATIO OF FINE TO COARSE AGGREGATE UPON THE WORKABILITY OF THE CONCRETE, AS IT IS WELL KNOWN THAT, IN GENERAL, MORE GRAVEL MAY BE USED WITH A GIVEN MORTAR CONTENT THAN CRUSHED STONE. AN ATTEMPT WILL BE MADE TO SHOW HOW SUCH A SITUATION MAY BE HANDLED ON A WEIGHT BASIS.

A SPECIFIC CASE WILL BE CITED. SUPPOSE THE HIGHWAY DEPARTMENT WISHES TO CONVERT A 1:2:3½ NOMINAL VOLUMETRIC MIX INTO A WEIGHT PROPORTION, IN SUCH A WAY THAT VARIATION IN YIELD DUE TO DIFFERENCES IN SPECIFIC GRAVITY WILL BE ELIMINATED.

THE FOLLOWING COARSE AGGREGATES ARE AVAILABLE:

TYPE	SPECIFIC GRAVITY:	WT. PER CU. FT. (AS USED)	PER CENT OF VOIDS
GRAVEL	2.65	102	38
TRAP	3.00	103	45
LIMESTONE A	2.75	95	45
LIMESTONE B	2.55	87	45
SAND	2.65	91	45







IF IN THIS CASE WE PROPORTION ON THE BASIS OF THE SAME ABSOLUTE VOLUMES IN ORDER TO CONTROL YIELD IT WILL BE NECESSARY TO SELECT A VALUE WHICH WILL GIVE SATISFACTORY WORKABILITY IN THE CASE OF EACH AGGREGATE, AVOIDING ON THE ONE HAND TOO MUCH STONE, AS WOULD BE THE CASE WERE WE TO SELECT THE ABSOLUTE VOLUME OF THE GRAVEL AS THE BASIS FOR OUR CALCULATION AND ON THE OTHER HAND TOO HIGH A MORTAR CONTENT IN THE GRAVEL CONCRETE WERE WE TO SELECT THE ABSOLUTE VOLUME OF THE STONE AS THE BASE.

AS AN ILLUSTRATION, SUPPOSE WE SELECT AN ABSOLUTE VOLUME OF 0.58 (CORRESPONDING TO A VOID CONTENT OF 42 PER CENT). USING THIS AS A BASE THE ABSOLUTE VOLUME FOR EACH COARSE AGGREGATE FOR EACH BAG OF CEMENT WILL BE

$$0.58 \times 3.5 = 2.03 \text{ CUBIC FEET.}$$

THE CORRESPONDING WEIGHTS FOR EACH OF THE FOUR AGGREGATES WILL THEN BE

FOR THE GRAVEL	$2.65 \times 62.4 \times 2.03 = 335 \text{ POUNDS.}$
" " TRAP	$2.71 \times 62.4 \times 2.03 = 380 \text{ POUNDS.}$
" LIMESTONE A	$2.75 \times 62.4 \times 2.03 = 348 \text{ POUNDS.}$
" " B	$2.55 \times 62.4 \times 2.03 = 323 \text{ POUNDS.}$

CONVERTING EACH OF THESE VALUES INTO THE EQUIVALENT APPARENT VOLUMES FOR PURPOSES OF COMPARISON WE HAVE

FOR THE GRAVEL	$\frac{335}{102} = 3.3$	PARTS BY VOLUME.
" " TRAP	$\frac{380}{103} = 3.7$	" " "
" LIMESTONE A	$\frac{348}{95} = 3.7$	" " "
" " B	$\frac{323}{87} = 3.7$	" " "

THE ABOVE EXAMPLE ILLUSTRATES THE DIFFICULTY OF APPLYING THIS METHOD OF PROPORTIONING WHEN DEALING WITH TWO DISSIMILAR MATERIALS SUCH AS CRUSHED STONE AND GRAVEL. FOR EQUIVALENT YIELDS AND FOR A GIVEN CEMENT-SAND RATIO WE WILL ALWAYS OBTAIN A SMALLER APPARENT VOLUME OF GRAVEL THAN STONE, WHEREAS FROM THE STANDPOINT OF WORKABILITY EXPERIENCE TEACHES US THAT WE CAN USE MORE GRAVEL THAN BROKEN STONE IN A GIVEN MORTAR.



## ALTERNATE METHOD OF HANDLING GRAVEL AND STONE MEASUREMENT

THERE IS ANOTHER WAY, HOWEVER, IN WHICH THE SITUATION MIGHT BE HANDLED WHICH WOULD GIVE THE SAME YIELD FOR EACH MATERIAL AND STILL RECOGNIZE THE FACT THAT THE STONE CONCRETE SHOULD CONTAIN MORE MORTAR. THIS WOULD BE TO USE WEIGHTS OF COARSE AGGREGATE CORRESPONDING TO THE SAME APPARENT VOLUMES (IN THIS CASE 3.5 PARTS) AND TO INCREASE THE VOLUME OF SAND IN THE CRUSHED STONE CONCRETE TO GIVE THE SAME TOTAL ABSOLUTE VOLUME OF AGGREGATE AND THEREFORE THE SAME YIELD AS THE GRAVEL CONCRETE. LET US CONTINUE THE SAME ILLUSTRATION:

THE ABSOLUTE VOLUME OF GRAVEL CORRESPONDING TO 3.5 CUBIC FEET APPARENT VOLUME WILL BE

$$(1.00 - 0.38) \times 3.5 = 2.17 \text{ CUBIC FEET.}$$

AND FOR THE TRAP ROCK WILL BE

$$(1.00 - 0.45) \times 3.5 = 1.93 \text{ CUBIC FEET.}$$

OR A DIFFERENCE OF 0.24 CUBIC FEET.

THE ABSOLUTE VOLUME OF SAND CORRESPONDING TO 2 CUBIC FEET APPARENT VOLUME WILL BE

$$(1.00 - 0.45) \times 2 = 1.10 \text{ CUBIC FEET.}$$

ADDING 0.24 CUBIC FEET IN THE CASE OF THE STONE CONCRETE WE HAVE A TOTAL ABSOLUTE VOLUME OF 1.34 CUBIC FEET OF SAND TO USE IN THE STONE CONCRETE CORRESPONDING TO 1.10 CUBIC FEET IN THE GRAVEL CONCRETE.

REDUCING THESE VALUES TO WEIGHTS, WE HAVE,

FOR THE GRAVEL	94	:	180	:	358
Do STONE	94	:	221	:	361

AND TO APPARENT VOLUMES,

FOR THE GRAVEL	1	:	2	:	3.5
Do TRAP	1	:	2.43	:	3.5

THE VALUE OF THIS METHOD WILL OF COURSE DEPEND ON WHETHER A 1 :  $2\frac{1}{3}$  MORTAR WILL MAKE JUST AS GOOD CONCRETE WITH CRUSHED STONE AS A 1 : 2 MORTAR WITH GRAVEL. THIS IS A MATTER WHICH CAN ONLY BE DETERMINED BY LABORATORY TEST FOR EACH MATERIAL ENCOUNTERED. HOWEVER, THE TWO ABOVE DESCRIBED METHODS ARE THE ONLY ONES WHICH CAN BE USED IN FIXING THE PROPORTION SO AS TO GIVE THE SAME YIELD WHEN BOTH GRAVEL AND CRUSHED STONE ARE INVOLVED.

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## MATERIALS ENGINEERS TAKE AN EXAMINATION

CONTRIBUTED BY F. H. JACKSON OF THE DIVISION OF TESTS

AT THE CONCLUSION OF THE TWO-WEEKS INSTRUCTION COURSE IN THE HEADQUARTERS OFFICE AND LABORATORY, THE DISTRICT MATERIALS ENGINEERS TOOK AN EXAMINATION, ON JANUARY 27, COVERING THE VARIOUS PHASES OF THE SUBJECTS DISCUSSED AT THE MEETINGS. THE 32 QUESTIONS, WHICH COVER PHASES OF THE WORK WITH WHICH A MATERIALS ENGINEER MUST BE FAMILIAR, ARE GIVEN BELOW. THE QUESTIONS MARKED WITH AN ASTERISK WERE OPTIONAL. THE MOST SATISFACTORY ANSWER TO EACH QUESTION WILL BE GIVEN IN THE NEXT ISSUE OF THE NEWS LETTER WITH THE NAMES OF THE ENGINEERS BY WHOM THEY ARE SUBMITTED. IN THE MEAN-TIME, ALL READERS ARE INVITED TO TEST THEMSELVES.

1. - WHAT IS THE PRINCIPAL CAUSE OF UNSOUNDNESS IN PORTLAND CEMENT? HOW IS IT DETECTED IN THE LABORATORY AND HOW MAY IT BE CORRECTED HAVING ONCE BEEN DETECTED IN THE FINISHED PRODUCT?

\*2. - DISCUSS BRIEFLY THE REASONS WHY A PORTLAND CEMENT WHICH HAS A TENDENCY TO RUN UNSOUND WILL FREQUENTLY SHOW HIGHER STRENGTH THAN A THOROUGHLY SOUND CEMENT. WHAT TWO DETAILS OF THE MANUFACTURING PROCESS ARE CHIEFLY RESPONSIBLE FOR SECURING A SOUND PRODUCT WITHOUT SACRIFICING STRENGTH?

3. - WHAT ARE THE PRESENT SPECIFICATION REQUIREMENTS FOR STRENGTH OF PORTLAND CEMENT?

4. - DISCUSS THE TEST RESULTS GIVEN BELOW FOR EACH OF THE FOLLOWING FIVE CONCRETE SANDS:

	A	B	C	D	E
RETAINED ON 1/4-INCH	0	5	0	0	0
RETAINED ON No.10	10	30	10	0	10
PASSING No.50	25	10	25	30	25
PASSING No.100	5	0	5	10	5
PER CENT OF SILT	2.1	0	1.1	3.0	1.1
COLOR TEST	QUESTIONABLE	O.K.	O.K.	O.K.	QUESTIONABLE
STRENGTH RATIO					
7 DAYS	98	140	75	85	75
28 DAYS	103	130	60	90	60

INDICATE IN EACH CASE WHETHER YOU WOULD OR WOULD NOT ACCEPT THE SAND FOR USE IN A CONCRETE PAVEMENT ON THE BASIS OF THE TEST RESULTS AND IF NOT, WHY NOT.





\*5. - NAME FOUR DISTINCT CHARACTERISTICS OF A CONCRETE SAND WHICH MAY AFFECT THE STRENGTH-RATIO TEST.

\*6. - DESCRIBE BRIEFLY THE METHOD OF MAKING A COLOR TEST FOR ORGANIC IMPURITIES IN CONCRETE SAND.

7. - WHAT ARE THE PREDOMINATING PHYSICAL CHARACTERISTICS OF THE SO-CALLED "TRAP" ROCKS AND FOR WHICH TYPE OF ROAD CONSTRUCTION ARE THEY PARTICULARLY WELL ADAPTED?

8. - NAME THE THREE PRINCIPAL GROUPS AS REGARDS ORIGIN INTO WHICH ROAD BUILDING ROCKS ARE USUALLY DIVIDED. TO WHICH DO THE FOLLOWING TYPES BELONG?

BASALT  
SCHIST  
SANDSTONE  
MARBLE  
GNEISS

WHAT PHYSICAL CHARACTERISTIC OF THE LAST TYPE MENTIONED ABOVE MAKES IT SOMETIMES UNDESIRABLE FOR USE AS A CONCRETE AGGREGATE?

9. - WHAT PARTICULAR KIND OF LIMESTONE SHOULD ALWAYS BE VIEWED WITH SUSPICION WHEN JUDGED FROM THE STANDPOINT OF DURABILITY AS A CONCRETE AGGREGATE?

10. - UNDER WHAT CIRCUMSTANCES WOULD YOU BE WILLING TO WAIVE

(A) - THE ABRASION TEST ON A LIMESTONE INTENDED FOR USE AS AN AGGREGATE IN A CONCRETE PAVEMENT?

(B) - THE SODIUM SULPHATE SOUNDNESS TEST ON A LIMESTONE INTENDED FOR THE SAME PURPOSE?

\*11. - NAME THREE GENERAL PRINCIPLES AS REGARDS SIZE AND GRADATION OF AGGREGATES WHICH MAY BE SAID TO GOVERN THE PROPER RATIO IN WHICH FINE AND COARSE AGGREGATES SHOULD BE COMBINED TO GIVE MAXIMUM WORKABILITY WITH ECONOMY.

12. - COMPUTE THE PROPER RATIO OF FINE TO COARSE AGGREGATE FOR EACH OF THE FOLLOWING TWO EXAMPLES, USING THE FINENESS MODULUS METHOD AND UNDER THE ASSUMPTIONS GIVEN:

(A) - FINENESS MODULUS, COARSE AGGREGATE .... 8.0  
DO DO FINE DO .... 3.4  
MAXIMUM PERMISSIBLE FINENESS MODULUS,  
COMBINED AGGREGATE ..... 6.5



(B) - FINENESS MODULUS, COARSE AGGREGATE	....	6.5
Do DO FINE DO	....	2.5
MAXIMUM PERMISSIBLE FINENESS MODULUS,		
COMBINED AGGREGATE	.....	5.8

13. - ASSUMING A PLASTIC MIXTURE CONTAINING NO AIR VOIDS, COMPUTE FOR EACH EXAMPLE THE NUMBER OF BARRELS OF CEMENT NECESSARY TO PRODUCE A CUBIC YARD OF CONCRETE FOR A 1:2:4 MIX BY VOLUME UNDER THE FOLLOWING CONDITIONS:

(A) - WEIGHT PER CUBIC FOOT OF COARSE AGGREGATE	105	LBS.
SPECIFIC GRAVITY DO DO DO	2.70	
WEIGHT PER CUBIC FOOT OF FINE AGGREGATE	85	LBS.
SPECIFIC GRAVITY DO DO DO	2.65	
WATER, 5-1/2 GALLONS PER BAG OF CEMENT		

(B) - SPECIFIC GRAVITY OF COARSE AGGREGATE	...	3.0
PERCENTAGE OF VOIDS IN DO DO	...	45
SPECIFIC GRAVITY OF FINE AGGREGATE	....	2.65
PERCENTAGE OF VOIDS IN FINE AGGREGATE	..	35
WATER, 6 GALLONS PER BAG OF CEMENT		

14. - DEFINE THE FOLLOWING TERMS AS APPLIED TO CONCRETE AND CONCRETE AGGREGATES: FINENESS MODULUS, ABSOLUTE VOLUME, DENSITY, WATER-CEMENT RATIO, AND "BULKING" AS APPLIED TO SAND.

\*15. - IN WHAT TWO FORMS MAY WATER BE SAID TO EXIST IN CONCRETE WHICH HAS THOROUGHLY HARDENED WITHOUT DRYING OUT? DESCRIBE HOW THE CURING PROCESS AS APPLIED TO CONCRETE MAY AFFECT ITS WATER TIGHTNESS.

16. - UPON WHAT PRINCIPLE DOES THE INUNDATION METHOD OF MEASURING SAND DEPEND?

17. - WHAT ARE SOME OF THE PRINCIPAL ADVANTAGES OF SPECIFYING AGGREGATES FOR CONCRETE BY WEIGHT?

18. - EXPLAIN WHY IT WOULD BE INADVISABLE TO SPECIFY DEFINITE WEIGHTS OF CEMENT AND AGGREGATES FOR CONCRETE FOR A REGION WITHIN WHICH VARIOUS TYPES OF MATERIAL MAY BE AVAILABLE.

19. - WHAT TEST FOR QUALITY OF BLAST FURNACE SLAG IS USUALLY APPLIED IN SPECIFICATIONS WHICH IS NOT USED FOR EITHER CRUSHED STONE OR GRAVEL?

20. - DEFINE THE VARIOUS ELEMENTS IN THE FOLLOWING FORMULA:  

$$W = 1200 D$$

21. - IN WHAT LOCATIONS WOULD YOU USE GALVANIZED METAL CULVERTS? IN WHAT LOCATIONS WOULD YOU CONSIDER SOME OTHER TYPE OF CULVERT MORE ECONOMICAL?



22. - IN BUYING GALVANIZED METAL CULVERTS WHAT TYPE OF BASE METAL WOULD YOU SPECIFY, AND WHY?

23. - WHAT CONSIDERATIONS WOULD YOU HAVE IN MIND IN SPECIFYING PAINT FOR PROTECTING STEEL AGAINST CORROSION?

- (A) - SHOP COAT
- (B) - FIRST FIELD COAT
- (C) - SECOND FIELD COAT

24. - GIVE A LIST OF THE TESTS USUALLY MADE ON:

- (A) - ASPHALTS
- (B) - TARS FOR CONSTRUCTION
- (C) - ROAD OILS
- (D) - ROAD TARS

25. - WHAT TEST (OR TESTS) IS USED FOR DETERMINING THE CONSISTENCY OF:

- (A) - ASPHALTS
- (B) - TARS FOR CONSTRUCTION
- (C) - ROAD OILS
- (D) - ROAD TARS

26. - WHAT IS THE OBJECT OF MAKING A DETERMINATION FOR THE PERCENTAGE OF MATERIAL THAT AN ASPHALT LOSES WHEN SUBJECTED TO THE HEAT TEST AT  $163^{\circ}\text{C}.$  ( $325^{\circ}\text{F}.$ ) IN AN OVEN FOR FIVE HOURS?

\*27. - OUR SPECIFICATION FOR ROAD OIL, DESIGNATED AS OC-2, PROVIDES FOR OILS FOR USE IN THE COLD SURFACE APPLICATION TREATMENT OF ROADS IN ORDER TO FORM A MAT OR WEARING SURFACE. THIS SPECIFICATION IS INTENDED TO COVER CERTAIN TYPES OF CRUDE OR TOPPED PETROLEUMS AND CUT-BACK ASPHALT. WHY IS A MAXIMUM FLASH-POINT REQUIREMENT SPECIFIED IN THIS SPECIFICATION INSTEAD OF A MINIMUM FLASH-POINT REQUIREMENT AS IS THE CASE IN OUR OTHER SPECIFICATIONS FOR ROAD OILS AND OUR ASPHALT SPECIFICATIONS?

28. - DETERMINE THE PERCENTAGE OF VOIDS IN A SAMPLE OF PAVEMENT, GIVEN THE FOLLOWING:

SPECIFIC GRAVITY OF SAMPLE = 2.20

COMPOSITION OF MIXTURE USED IN PAVEMENT:

ASPHALT CEMENT .....	10.0 PER CENT BY WEIGHT
MINERAL AGGREGATE .....	90.0 DO
SPECIFIC GRAVITY OF ASPHALT CEMENT	1.03
DO DO DO MINERAL AGGREGATE	2.65





29. - (A) HOW MANY POUNDS OF AN ASPHALT CEMENT CONTAINING 99.8 PER CENT OF BITUMEN SHOULD BE ADDED TO 900 POUNDS OF SAND AND PORTLAND CEMENT IN ORDER THAT THE RESULTING MIXTURE SHALL CONTAIN 10.0 PER CENT OF BITUMEN (TOLERANCE  $\pm 0.1$  PER CENT)?

(B) HOW MANY POUNDS OF AN ASPHALT CEMENT CONTAINING 80.0 PER CENT OF BITUMEN SHOULD BE ADDED TO 900 POUNDS OF SAND AND PORTLAND CEMENT IN ORDER THAT THE RESULTING MIXTURE SHALL CONTAIN 10.0 PER CENT OF BITUMEN (TOLERANCE  $\pm 0.1$  PER CENT)?

30. - OF WHAT VALUE IS THE DUCTILITY TEST?

\*31. - EXPLAIN THE DIFFERENCE BETWEEN THE SIGNIFICANCE OF TOTAL BITUMEN (SOLUBLE IN CARBON DISULPHIDE) AND PROPORTION OR PERCENTAGE OF BITUMEN SOLUBLE IN CARBON TETRACHLORIDE, IN CONNECTION WITH THE ANALYSES OF ASPHALTS.

32. - IN MAKING AN ANALYSIS OF A BITUMINOUS AGGREGATE FOR PERCENTAGE OF BITUMEN AND GRADING OF MINERAL AGGREGATE (AND SOME ASPHALTS FOR PERCENTAGE OF BITUMEN) WHAT CORRECTION IN THE DETERMINATION SHOULD BE MADE AND WHY? IF THIS CORRECTION IS NOT MADE, WHAT TWO RESULTS IN THE ANALYSIS OF THE BITUMINOUS AGGREGATES WILL BE AFFECTED AND HOW?



UNITED STATES DEPARTMENT OF AGRICULTURE  
BUREAU OF PUBLIC WORKS

STATUS OF CURRENT FEDERAL-AID ROAD WORK  
FOR THE FISCAL YEAR ENDING JUNE 30, 1928

AS OF JANUARY 31, 1928

STATES	* UNDER CONSTRUCTION			APPROVED FOR CON- STRUCTION			AMOUNT PAID STATES DURING FISCAL YEAR			COMPLETED AND PAID DURING FISCAL YEAR			AGREEMENTS NOW IN FORCE			P. S. & E. RECOMMENDED FOR APPROVAL BY DISTRICT ENGINEER			STATES							
	FEDERAL AID		MILEAGE	FEDERAL AID		MILEAGE	FEDERAL AID		MILEAGE	FEDERAL AID		MILEAGE	FEDERAL AID		MILEAGE	FEDERAL AID		MILEAGE								
	ORIGINAL	STAGE		ORIGINAL	STAGE		ORIGINAL	STAGE		ORIGINAL	STAGE		ORIGINAL	STAGE		ORIGINAL	STAGE									
Alabama	\$ 4,454,334.80	510.2	1.9	\$ 315,072.81	19.9	24.8	\$ 335,685.20	42.1	1.9	\$ 3,539,549.28	409.1	24.8	\$ 3,539,549.28	409.1	1.9	\$ 930,458.13	121.0	24.8	Alabama							
Arizona	2,435,120.20	241.0	4.4	17,254.44	0.2	0.8	151,055.92	15.7	5.0	1,844,938.70	266.3	5.0	1,844,938.70	266.3	5.0				Arizona							
Arkansas	2,435,120.20	215.0	2.1	17,254.44	0.2	0.8	222,915.49	16.7	5.0	1,754,470.48	231.0		1,754,470.48	231.0		360,556.92	10.0		Arkansas							
California	4,912,453.15	164.2	5.7	13,452.03	9.4	9.4	1,302,905.10	84.7	0.3	1,699,840.46	147.3	5.7	1,699,840.46	147.3	5.7	339,389.11	16.3	5.7	California							
Colorado	3,613,994.80	286.1	12.4	20,057.34	2.9	2.9	644,595.64	48.6	0.9	3,176,126.80	271.1	12.4	3,176,126.80	271.1	12.4	312,826.05	16.9		Colorado							
Connecticut	680,332.03	1,597,373.39	69.6	191,245.72	12.0	12.0	162,520.95	387,625.33	17.7	1,579,095.08	75.1		1,579,095.08	75.1		109,535.02	6.5		Connecticut							
Delaware	385,625.26	267,069.47	16.3	21,241.85	29.4	29.4	232,041.85	29.4		244,686.47	16.3	2.1	244,686.47	16.3	2.1	17,382.00			Delaware							
Florida	1,351,001.52	2,396,757.80	133.0	552,525.30	37.8	37.8	1,024,358.33	1,947,518.78	75.4	24.7	2,287,885.65	133.0	24.7	2,287,885.65	133.0	24.7	681,714.55	37.8	5.5	Florida						
Georgia	1,351,951.45	2,241,128.26	167.4	227,354.02	34.8	34.8	1,615,342.53	2,934,490.77	225.5	106.3	2,113,269.07	150.3	106.3	2,113,269.07	150.3	50.8	355,224.21	41.9	2.5	Georgia						
Idaho	1,030,807.27	1,306,353.28	142.3	65,000.00	10.8	10.8	763,451.64	949,884.29	111.0	14.8	948,705.30	113.5	14.8	948,705.30	113.5	21.2	423,157.59	39.6	37.8	Idaho						
Illinois	4,599,079.57	7,691,175.60	538.6	1,089,102.31	78.3	78.3	1,696,730.33	191,977.92	15.0		7,371,592.99	568.7		7,371,592.99	568.7		1,378,884.92	98.2	2.2	Illinois						
Indiana	1,353,475.89	9,103,135.17	313.2	1,017,659.38	90.1	0.6	1,695,675.38	4,627,177.27	34.5		7,841,976.56	501.5		7,841,976.56	501.5		1,263,682.13	91.7	0.6	Indiana						
Iowa	2,353,319.01	4,643,249.80	283.1	1,033,579.56	7.4	87.6	2,472,146.59	1,588,101.78	34.0	66.5	4,866,899.48	287.7	66.5	4,866,899.48	287.7	13.3	1,409,813.50	12.8	111.5	Iowa						
Kansas	1,500,585.24	1,500,585.24	59.8	25,000.00	5.4	5.4	2,423,361.02	1,797,079.21	281.8	4.9	4,856,354.08	93.7	4.9	4,856,354.08	93.7	9.3	150,813.52	22.3	3.9	Kansas						
Kentucky	1,400,257.11	4,622,263.41	418.9	25,000.00	5.4	5.4	1,753,337.25	1,753,337.25	33.8	5.8	4,856,354.08	118.8	5.8	4,856,354.08	118.8	59.8	74,358.33	8.7		Kentucky						
Louisiana	979,509.22	1,822,881.90	138.4	1,111,116.29	83.3	7.5	505,416.41	597,801.48	43.7	51.9	2,639,626.52	49.5	51.9	2,639,626.52	49.5	7.5	727,356.26	63.1		Louisiana						
Maine	1,735,312.82	534,670.62	43.9	43,955.00	5.6	5.6	357,250.92	594,650.89	51.9		649,147.17	62.2		649,147.17	62.2					Maine						
Maryland	619,115.50	698,347.17	52.2	201,480.00	13.4	13.4	158,264.74	158,264.74	9.6		1,865,290.01	115.4		1,865,290.01	115.4		47,400.00			Maryland						
Massachusetts	2,635,671.10	1,865,250.01	115.4	485,027.00	32.3	6.5	1,507,222.57	118.5			4,558,375.50	301.8	12.6	4,558,375.50	301.8	12.6	1,792,467.00	73.1	6.5	Massachusetts						
Michigan	2,680,101.94	5,865,815.50	347.6	408,000.00	30.8	31.0	1,954,943.69	2,001,398.30	248.7	110.3	575,100.00	180.8	110.3	575,100.00	180.8	3.8	965,000.00	126.6	31.0	Michigan						
Minnesota	1,236,471.43	1,131,100.00	216.6	408,000.00	90.8	31.0													Minnesota							
Mississippi	1,783,592.45	2,865,018.70	303.7	143,699.06	29.9	29.9	1,325,317.03	989,021.17	110.6	4.9	2,765,771.79	301.4	22.9	2,765,771.79	301.4	22.9	238,945.97	32.2		Mississippi						
Missouri	2,972,770.84	3,154,252.43	236.0	182,843.62	24.0	24.0	1,991,734.22	1,605,064.53	124.1	21.9	3,132,685.20	238.0	21.9	3,132,685.20	238.0	26.5	204,437.85	24.0	3.9	Missouri						
Montana	5,584,159.02	2,603,031.44	334.0	953,821.41	114.3	8.4	1,277,695.05	370,850.44	51.2	4.9	3,328,913.69	442.4	8.4	3,328,913.69	442.4	8.4	39,735.15	5.9		Montana						
Nebraska	1,590,194.92	5,804,015.44	1,167.1	242,845.23	48.5	39.7	1,964,916.17	2,068,912.12	412.9	452.1	5,851,034.56	1,199.4	452.1	5,851,034.56	1,199.4	426.2	155,826.11	16.2	21.8	Nebraska						
Nevada	1,500,585.24	1,500,585.24	186.1	49,355.46	8.7	3.0	576,105.74	495,668.11	87.8	10.7	1,394,334.01	171.1	26.0	1,394,334.01	171.1	26.0	159,112.78	23.7	3.0	Nevada						
New Hampshire	1,372,355.24	372,355.24	5.3	23,635.00	1.8	1.8	262,635.76	315,165.24	23.7		434,012.07	27.7		434,012.07	27.7					New Hampshire						
New Jersey	935,132.00	817,294.17	53.3	77,377.35	5.5	5.5	1,012,035.00	1,012,035.00	97.5		917,294.17	53.3		917,294.17	53.3		77,337.35			New Jersey						
New Mexico	2,446,862.15	2,446,862.15	207.5				342,978.68	535,454.33	67.5		2,411,806.37	199.8		2,411,806.37	199.8		36,799.00	7.7		New Mexico						
New York	6,715,286.78	10,565,541.46	556.7	909,952.50	58.2	8.6	3,395,123.31	1,422,554.92	95.7		11,545,945.95	710.9	8.6	11,545,945.95	710.9	8.6	59,850.00	4.0		New York						
North Carolina	2,266,269.97	1,577,515.52	92.9	74,000.00	5.4	5.4	787,000.00	729,783.36	63.3		1,309,016.52	82.7	28.8	1,309,016.52	82.7	28.8	342,500.00	35.6	5.8	North Carolina						
North Dakota	1,934,916.04	2,161,697.19	671.4	203,071.11	101.2	43.6	1,090,658.28	1,674,127.76	369.1	208.3	2,055,354.64	713.5	259.7	2,055,354.64	713.5	42.2	354,359.88	59.1		North Dakota						
Ohio	5,001,209.62	3,895,995.03	258.2	1,553,795.01	61.2	4.2	1,435,818.19	1,978,592.53	155.0		3,139,395.19	321.9	4.2	3,139,395.19	321.9	4.2	1,752,103.86	55.1	47.5	Ohio						
Oklahoma	1,637,522.06	2,924,596.40	396.5	501,281.34	67.5	3.9	675,815.05	379,750.88	9.6	17.9	2,619,505.08	376.6	35.6	2,619,505.08	376.6	35.6	55,824.87	0.8		Oklahoma						
Oregon	1,596,711.23	1,426,337.68	75.5	58,953.27	0.9	0.9	424,965.88	371,764.88	11.3		1,620,620.70	359.5		1,620,620.70	359.5					Oregon						
Pennsylvania	4,359,749.96	5,391,479.96	337.3	545,835.47	36.0	2.9	2,247,920.45	1,233,613.17	97.8		5,710,620.70	359.5	2.9	5,710,620.70	359.5	2.9	256,597.85	14.8	8.1	Pennsylvania						
Rhode Island	693,722.53	399,422.01	23.4	99,990.00	6.6	6.6	296,397.48	227,205.00	15.1		405,937.41	25.2		405,937.41	25.2		93,475.00	4.8		Rhode Island						
South Carolina	1,915,165.09	2,219,655.72	227.7	116.8	116.8	10.0	722,045.80	1,013,254.39	99.0	7.7	2,099,475.41	199.5	89.7	2,099,475.41	199.5	89.7	358,150.31	45.2	37.1	South Carolina						
South Dakota	1,041,059.39	2,978,121.58	730.4	135.1	135.1	47.5	512,552.13	2,834,936.59	68.5	42.9	2,921,747.79	785.5	152.7	2,921,747.79	785.5	152.7	275,555.59	37.6	30.0	South Dakota						
Tennessee	1,041,059.39	2,978,121.58	730.4	135.1	135.1	47.5	512,552.13	2,834,936.59	68.5	36.4	2,921,747.79	785.5	23.8	2,921,747.79	785.5	23.8	1,427,720.24	99.4		Tennessee						
Texas	1,041,059.39	2,978,121.58	730.4	135.1	135.1	47.5	512,552.13	2,834,936.59	68.5	80.0	2,921,747.79	785.5	244.7	2,921,747.79	785.5	244.7	6,094,705.12	128.8		Texas						
Utah	1,041,059.39	2,978,121.58	730.4	135.1	135.1	47.5	512,552.13	2,834,936.59	68.5		1,954,135.57	155.3	11.1	1,954,135.57	155.3	11.1	115,713.52	7.6	3.4	Utah						
Vermont	395,766.54	684,331.78	43.7				-571,822.87	27.9			693,331.78	43.7		693,331.78	43.7					Vermont						
Washington	1,275,355.92	1,930,082.88	103.0	192,019.27	6.5	6.4	1,083,558.23	447,174.68	27.3		1,828,424.39	103.2	4.0	1,828,424.39	103.2	4.0	193,677.76	6.4	6.4	Washington						
West Virginia	1,028,945.05	1,953,670.53	123.3	11,329.47	0.1		204,053.52	475,755.32	22.3		1,830,900.00	119.7		1,830,900.00	119.7		154,000.00	3.7		West Virginia						
Wisconsin	2,681,927.10	2,891,927.10	268.9	64,721.66	6.7		596,515.45	774,376.18	51.4	8.0	2,745,548.76	235.6	4.0	2,745,548.76	235.6	4.0				Wisconsin						
Wyoming	3,673,595.28	3,673,595.28	34.5				2,415,735.10	2,158,487.04	306.5	9.5	3,308,055.96	260.0		3,308,055.96	260.0		195,454.00			Wyoming						
Hawaii	1,171,600.38	1,171,600.38	25.0				912,535.11	1,382,695.58	53.5	54.9		224.1								Hawaii						
TOTALS	104,900,241.19	140,815,834.61	12,950.4	14,538,730.36	1,420.3	393.7	53,976,051.56	47,292,452.50	4,567.0		135,072,119.35	12,908.7	1,859.3	135,072,119.35	12,908.7	1,859.3	20,382,495.82	1,532.0	441.9	TOTALS						
																			Mileage: Original		4,470.0		Stage		715.4	
* Includes projects reported completed (final vouchers not yet paid) totaling: Federal aid, \$ 49,285,345.71																										

\* Includes projects reported completed (final vouchers not yet paid) totaling: Federal aid, \$ 49,285,345.71 Mileage: Original





TREND OF CONCRETE PAVEMENT DESIGN - JANUARY 1, 1928.

CONTRIBUTED BY THE DIVISION OF DESIGN

(NOT FOR RELEASE)

THE TREND OF CONCRETE PAVEMENT DESIGN HAS REMAINED PRACTICALLY UNCHANGED SINCE THE ISSUE OF THE TABLE, IN THE NEWS LETTER OF JANUARY, 1927, SHOWING THE NUMBER OF PROJECTS SUBMITTED WITH THE UNIFORM THICKNESS, THIN-EDGE, AND THICKENED-EDGE CROSS SECTION DURING 1926.

AS MAY BE SEEN FROM THE ACCOMPANYING TABLE, THE NUMBER OF PROJECTS SUBMITTED IN 1927 IN EACH OF THESE THREE GROUPS REMAINS IN ABOUT THE SAME PROPORTION AS IN THE PRECEDING YEAR, ALTHOUGH THE TOTAL NUMBER OF PROJECTS IS LESS BY MORE THAN 5 PER CENT. THE THICKENED-EDGE PAVEMENTS IN 1927 CONSTITUTED 80 PER CENT OF THE DESIGNS SUBMITTED FOR FEDERAL AID; THE UNIFORM THICKNESS TOTALING 18 PER CENT, AND THE THIN-EDGE SLIGHTLY LESS THAN 2 PER CENT. ALL OF THE THIN-EDGE PAVEMENTS WERE SUBMITTED BY THE MARYLAND STATE ROADS COMMISSION. OF THE UNIFORM-THICKNESS TYPE 54 PER CENT WERE FOR THE 8-INCH AND 37 PER CENT FOR THE 7-INCH DEPTH. ALL OF THE THIN-EDGE DESIGNS WERE OF THE 6-8-6 CROSS SECTION. THE THICKENED-EDGE PROJECTS SHOW A MUCH WIDER RANGE IN THE DIMENSIONS. THE MOST UNIVERSALLY ACCEPTED CROSS SECTION IS THE 9-6-9 WHICH IS USED ON OVER 45 PER CENT OF THE PROJECTS; THE 9-7-9 DESIGN IS SECOND WITH 23 PER CENT; AND THE 8-6-8 THIRD WITH 8 PER CENT.

DURING 1927, 37 STATES USED THE THICKENED-EDGE DESIGN, 6 STATES THE UNIFORM THICKNESS, AND ONE STATE - MARYLAND - THE THIN-EDGE CROSS SECTION. IT IS UNDERSTOOD, HOWEVER, THAT MARYLAND WILL MAKE THE THICKENED-EDGE UNANIMOUS BY CHANGING OVER TO THAT TYPE DURING 1928. OF THE 542 CONCRETE-PAVEMENT PROJECTS, LISTED IN 1927, 350 WERE CLASSIFIED AS PLAIN AND 192 AS REINFORCED CONCRETE. THE BUREAU HAS CLASSIFIED THOSE DESIGNS REINFORCED WITH MARGINAL RODS, ONLY, AS PLAIN CONCRETE. THE DESIGNATION OF REINFORCED CONCRETE WAS RESERVED FOR PAVEMENTS HAVING RODS OR MESH DISTRIBUTED THROUGHOUT THE SLAB. UNDER THIS CLASSIFICATION 21 STATES, DURING 1927, BUILT PLAIN CONCRETE PAVEMENTS EXCLUSIVELY, 7 STATES CONSTRUCTED ONLY REINFORCED CONCRETE PAVEMENTS, AND 16 STATES COMPLETED SOME OF BOTH DESIGNS. DURING THE SAME YEAR, 5 STATES SPECIFIED BAR REINFORCEMENT, 10 STATES REQUIRED MESH, AND 8 STATES PERMITTED THE USE OF EITHER BAR OR MESH.



THE TREND OF DESIGN OF FEDERAL-AID CONCRETE-PAVEMENT PROJECTS,  
AS OF JANUARY 1, 1928.

(UNIFORM-THICKNESS PROJECTS)

DESIGN THICKNESS:			NUMBER OF FEDERAL-AID PROJECTS SUBMITTED BY YEARS												
EDGE:	CENTER:	EDGE:	1917:	1918:	1919:	1920:	1921:	1922:	1923:	1924:	1925:	1926:	1927:	TOTALS:	
IN. :	IN. :	IN. :	:	:	:	:	:	:	:	:	:	:	:	:	
5 :	5 :	5 :	- :	1 :	- :	1 :	2 :	1 :	- :	- :	- :	- :	- :	5	
6 :	6 :	6 :	2 :	3 :	3 :	24 :	24 :	49 :	10 :	4 :	3 :	3 :	8 :	133	
7 :	7 :	7 :	1 :	11 :	17 :	31 :	22 :	80 :	70 :	33 :	47 :	27 :	37 :	376	
7½ :	7½ :	7½ :	2 :	4 :	17 :	31 :	21 :	30 :	9 :	1 :	- :	2 :	- :	117	
8 :	8 :	8 :	4 :	17 :	68 :	90 :	78 :	85 :	61 :	51 :	44 :	57 :	53 :	608	
9 :	9 :	9 :	- :	1 :	13 :	9 :	9 :	8 :	8 :	- :	- :	7 :	1 :	56	
10 :	10 :	10 :	- :	- :	5 :	5 :	5 :	2 :	2 :	- :	1 :	2 :	- :	22	
12 :	12 :	12 :	- :	- :	- :	- :	- :	- :	2 :	- :	1 :	- :	- :	3	
TOTAL UNIFORM - :															
THICKNESS PROJECTS:			9 :	37 :	123 :	191 :	161 :	255 :	162 :	89 :	96 :	98 :	99 :	1,320	

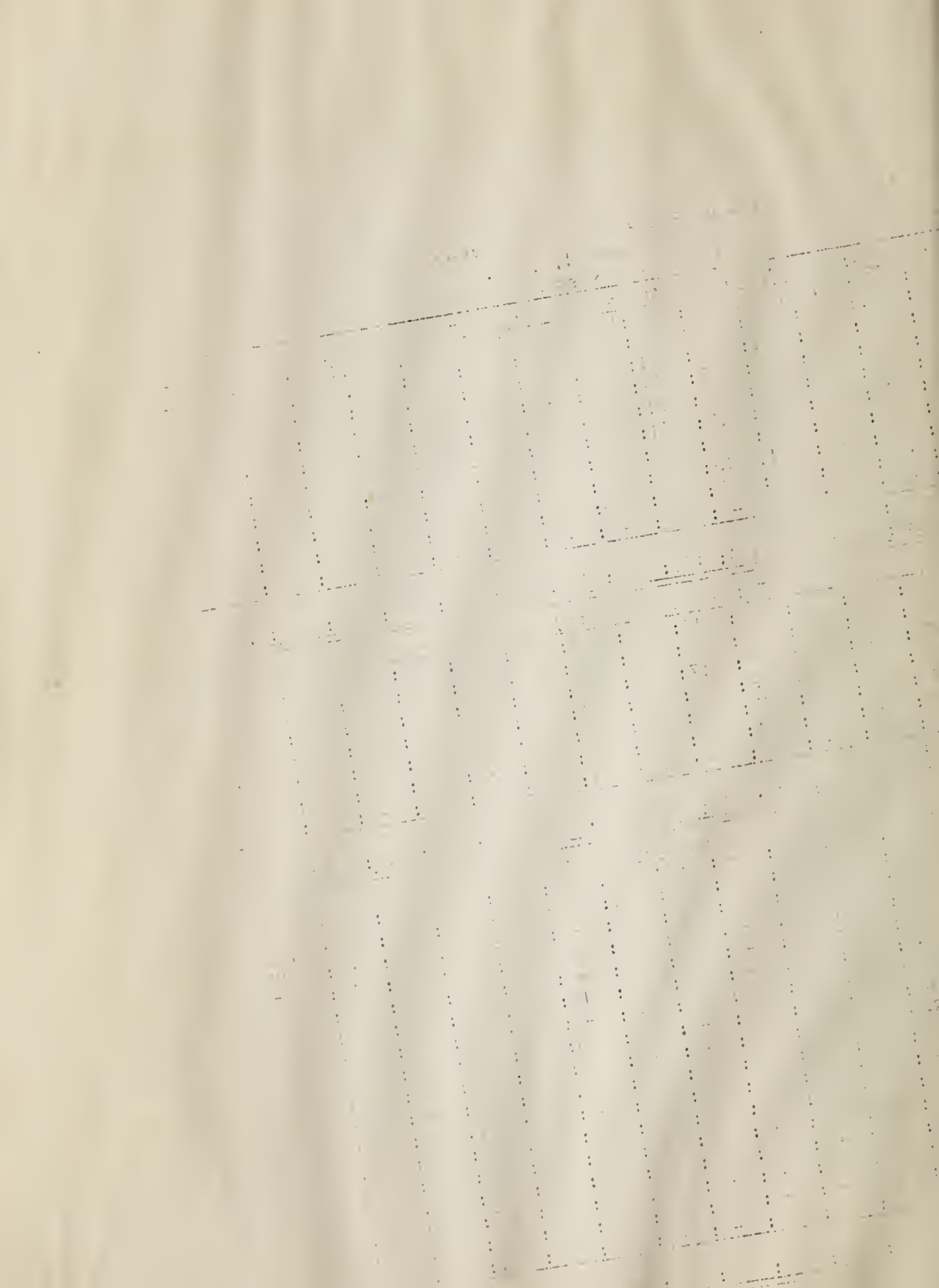
(THIN-EDGE PROJECTS)

5 :	6 :	5 :	- :	- :	1 :	11 :	3 :	1 :	- :	- :	- :	- :	- :	16
5 :	7 :	5 :	4 :	10 :	7 :	4 :	- :	3 :	- :	- :	- :	11 :	- :	29
6 :	7 :	6 :	- :	1 :	9 :	17 :	8 :	39 :	25 :	- :	- :	- :	- :	99
6 :	8 :	6 :	4 :	13 :	92 :	60 :	56 :	71 :	16 :	25 :	9 :	11 :	10 :	367
7 :	8 :	7 :	1 :	11 :	65 :	55 :	23 :	24 :	18 :	- :	- :	- :	- :	197
7 :	9 :	7 :	- :	- :	1 :	2 :	- :	2 :	4 :	- :	- :	- :	- :	9
8 :	10 :	8 :	- :	- :	- :	- :	- :	1 :	1 :	- :	- :	- :	- :	2
TOTAL THIN-EDGE :														
PROJECTS			9 :	35 :	175 :	149 :	90 :	141 :	64 :	25 :	9 :	12 :	10 :	719

(THICKENED-EDGE PROJECTS)

7 :	5 :	7 :	- :	- :	- :	- :	- :	1 :	- :	- :	- :	- :	- :	1
7 :	6 :	7 :	- :	- :	- :	- :	- :	1 :	23 :	38 :	43 :	24 :	5 :	134
7½ :	5½ :	7½ :	- :	- :	- :	- :	- :	- :	- :	- :	15 :	2 :	- :	17
7½ :	6 :	7½ :	- :	- :	- :	- :	- :	- :	- :	12 :	- :	6 :	19 :	37
8 :	5 :	8 :	- :	- :	- :	- :	- :	- :	- :	4 :	- :	- :	- :	4
8 :	6 :	8 :	- :	- :	- :	- :	1 :	8 :	17 :	21 :	72 :	52 :	34 :	205
8 :	6½ :	8 :	- :	- :	- :	- :	- :	- :	- :	- :	4 :	4 :	10 :	18
8 :	7 :	8 :	- :	- :	- :	- :	- :	- :	3 :	25 :	33 :	33 :	21 :	115
8½ :	6½ :	8½ :	- :	- :	- :	- :	- :	- :	- :	- :	- :	- :	1 :	1
8½ :	7 :	8½ :	- :	- :	- :	- :	- :	- :	- :	- :	- :	- :	1 :	1
9 :	5 :	9 :	- :	- :	- :	- :	- :	- :	- :	2 :	1 :	1 :	2 :	6
9 :	6 :	9 :	- :	- :	- :	- :	3 :	- :	55 :	180 :	160 :	192 :	197 :	787
9 :	6½ :	9 :	- :	- :	- :	- :	- :	- :	- :	22 :	34 :	34 :	15 :	105
9 :	7 :	9 :	- :	- :	- :	- :	- :	9 :	6 :	38 :	49 :	80 :	98 :	280
10 :	7 :	10 :	- :	- :	- :	- :	- :	2 :	1 :	5 :	3 :	26 :	25 :	62
10 :	8 :	10 :	- :	- :	- :	- :	- :	1 :	3 :	9 :	3 :	4 :	5 :	25
12 :	6 :	12 :	- :	- :	- :	- :	- :	- :	- :	- :	1 :	- :	- :	1
TOTAL THICKENED-:														
EDGE PROJECTS			- :	- :	- :	- :	4 :	22 :	108 :	356 :	418 :	458 :	433 :	1,799

GRAND TOTALS : 18: 72: 298: 340: 255: 418: 334: 470: 523: 568: 542:3,938





## CONSTRUCTION UNDER WAY ON ZION NATIONAL PARK ROAD

COMPILED FROM REPORTS SUBMITTED BY MR. FINCH, AND W. A. BLANCHETTE  
OF THE DIVISION OF MANAGEMENT

CONSTRUCTION IS NOW UNDER WAY ON THE ZION NATIONAL PARK ROAD, IN SOUTHWESTERN UTAH, CONSIDERED, BY THOSE WHO HAVE HAD AN OPPORTUNITY TO VIEW THE WORK, AS ONE OF THE MOST INTERESTING ROADBUILDING PROJECTS IN THE WORLD. THE WORK IS BEING DONE BY THE BUREAU UNDER AGREEMENT WITH THE NATIONAL PARK SERVICE.

THE PROJECT BEGINS AT THE CHECKING STATION FOR TOURISTS IN THE PARK (ELEVATION 4,100 FEET) AND, RUNNING GENERALLY EASTWARD ALONG THE SOUTH SIDE OF PINE CREEK, REACHES THE BASE OF THE CLIFFS, AT AN ALTITUDE OF 4,886 FEET, IN A DISTANCE OF 4 MILES. THROUGH THESE CLIFFS A TUNNEL IS BEING BORED FOR 5,582 FEET. THE SIDE WALLS OF THE TUNNEL ARE BEING BROKEN OUT AT INTERVALS, SIMILAR TO THE MITCHELL'S POINT SECTION OF THE FAMOUS COLUMBIA RIVER HIGHWAY IN OREGON, TO AFFORD BOTH LIGHT AND VENTILATION. THE 22-FOOT WIDTH OF THE TUNNEL WILL PROVIDE AMPLE ROOM FOR THE SAFE PASSAGE OF THE LARGEST BUSES AND TRUCKS. THE GRADE IN THE TUNNEL IS 5 PER CENT AND THE MAXIMUM GRADE ON THE PROJECT IS 6 PER CENT. THE MAXIMUM GRADE IS BEING USED IN A FEW PLACES WHERE THE ALIGNMENT IS GOOD, BUT AT ALL OTHER POINTS THE RULING GRADE IS 5 PER CENT.

FROM THE END OF THE TUNNEL, THE PROJECT CONTINUES THROUGH THE WINDING CANYONS OF UPPER PINE CREEK AND CLEAR CREEK TO THE EAST BOUNDARY OF THE PARK - A DISTANCE OF 3-1/2 MILES. IN ORDER TO OBTAIN SATISFACTORY ALIGNMENT, IT WILL BE NECESSARY TO CUT THROUGH THE STEEP RIDGES AT SEVERAL POINTS WITH SHORT TUNNELS - THE LONGEST 600 FEET IN LENGTH AND OTHERS 100 TO 300 FEET LONG. ALL THE SHORT TUNNELS ARE STRAIGHT SO THAT ARTIFICIAL LIGHTING WILL BE UNNECESSARY.

SINCE THE SANDSTONE THROUGH WHICH SECTIONS OF THE ROAD ARE BEING CONSTRUCTED WILL NOT RESIST THE DISINTEGRATING ACTION OF MOTOR-VEHICLE WHEELS, IT WILL BE NECESSARY TO SURFACE THESE PORTIONS OF THE PROJECT WITH GRAVEL TAKEN FROM THE BARS OF ZION CREEK OR WITH CRUSHED LIMESTONE QUARRIED FROM THE DEPOSITS EAST OF THE PARK BOUNDARY.

FOUR BRIDGES, RANGING IN LENGTH FROM 60 TO 200 FEET, WILL BE CONSTRUCTED ON THE 8-1/2-MILE PARK SECTION. TWO OF THESE BRIDGES, NEAR THE CHECKING STATION, WILL BE CONCRETE ARCHES FACED





WITH SANDSTONE MASONRY. MASONRY WILL ALSO BE USED FOR SOME OF THE SMALLER BRIDGE STRUCTURES VARYING FROM 12 TO 16 FEET IN SPAN.

THE COMPLETION OF THE APPROXIMATELY 24 MILES OF CONSTRUCTION UNDER CONSIDERATION, BETWEEN THE CHECKING STATION AND MT. CARMEL, WILL PROVIDE A SHORT CUT TO KANAB, UTAH, AND ELIMINATE THE LONG, ROUGH RIDE FROM HURRICANE, UTAH, TO FREDONIA, ARIZ., AND THENCE NORTH TO KANAB. A TABULATION INDICATING THE SAVINGS IN DISTANCE, MADE POSSIBLE BY THE NEW ROUTE, FOLLOWS:

POINT OF ORIGIN TO DESTINATION	:	PRESENT DISTANCE:	:	DISTANCE BY COMPLETED PROJECT
	:		:	
	:	MILES	:	MILES
CEDAR CITY TO MT. CARMEL	:	140	:	85
CEDAR CITY TO KANAB	:	122	:	100
CEDAR CITY TO GRAND CANYON (NORTH RIM)	:	197	:	190
ZION CANYON TO BRYCE CANYON	:	158	:	88
ZION CANYON TO GRAND CANYON (NORTH RIM)	:	143	:	125
MT. CARMEL TO ST. GEORGE	:	130	:	76
MT. CARMEL TO ZION PARK	:	92	:	26
	:		:	

THE CONTRACT FOR THE FIRST 5 MILES THROUGH THE PARK HAS BEEN AWARDED TO THE NEVADA CONTRACTING COMPANY OF FALLON, NEV., AT A TOTAL ESTIMATED PRICE OF \$607,058. FROM THE EAST PARK BOUNDARY THE UTAH STATE HIGHWAY DEPARTMENT HAS MADE A SURVEY FOR A FEDERAL-AID PROJECT, 15.2 MILES IN LENGTH, CONNECTING WITH THE GRAND CANYON HIGHWAY, ABOUT 2 MILES SOUTH OF MT. CARMEL. THE ESTIMATED COST OF THIS WORK IS \$350,000. IT IS EXPECTED THAT A CONTRACT WILL BE AWARDED FOR THIS SECTION SHORTLY.

THE TOPOGRAPHY OF THE COUNTRY MAKES IT NECESSARY TO BEGIN THE WORK ON THE GOING PROJECT AT ONE END (FIGS. 1 AND 2) AND MANY DIFFICULTIES HAVE BEEN ENCOUNTERED IN OPENING IT UP AT A NUMBER OF POINTS IN ORDER TO EXPEDITE THE CONSTRUCTION.

THREE GALLERIES (FIGS. 3 AND 4) HAVE BEEN OPENED FROM THE CLIFF FACE TO THE TUNNEL LINE AND THE FOURTH GALLERY IS ABOUT TO BE STARTED. A "PILOT" TUNNEL (FIG. 5) 9 FEET WIDE BY 8 FEET HIGH IS BEING DRIVEN BETWEEN THESE GALLERY OPENINGS ON THE GRADE AND CENTER LINE OF THE MAIN TUNNEL. THREE 8-HOUR SHIFTS ARE IN OPERATION AND THE BORE IS BEING MADE IN BOTH DIRECTIONS FROM THE GALLERY OPENINGS. SIMULTANEOUSLY WITH THE DRILLING AND BLASTING ON ONE FACE





FIGURE 1—THE WEST WALL OF THE CANYON ABOVE THE VIRGIN RIVER.  
THE NEW CONSTRUCTION CAMP IS LOCATED IN THE LOWER-LEFT  
CORNER OF THE PICTURE.



FIGURE 2—SHOVEL BUILDING A PIONEER ROAD FROM THE CAMP  
TO THE WEST PORTAL OF THE TUNNEL.









FIGURE 3- GALLERY NUMBER 2 TO THE "PILOT" TUNNEL IN WHICH DRILLING, BLASTING, AND MUCKING IS BEING CARRIED ON IN BOTH DIRECTIONS.



FIGURE 4 - THE LOADED CARS ARE PULLED TO THE GALLERY OPENING BY CABLES ATTACHED TO AIR HOISTS.





FIGURE 5 - SECTION OF "PILOT" TUNNEL BEING  
DRIVEN FROM GALLERY NUMBER 6  
TOWARD THE WEST PORTAL.



FIGURE 6 - THE BUTLER "SHUVELODER," USED  
FOR MUCKING THE SANDSTONE, IS OPERATED  
BY COMPRESSED AIR. IT REQUIRES ABOUT 30 SECONDS  
TO HANDLE A  $\frac{1}{4}$ -CUBIC-YARD DIPPER LOAD.





THE LOOSENEED SANDSTONE IS BEING EXCAVATED AND LOADED FROM THE OTHER. THE MUCKING IS BEING ACCOMPLISHED WITH A BUTLER SHUVELDER (FIG. 6) EQUIPPED WITH A 1/4-CUBIC YARD BUCKET, AND OPERATED BY COMPRESSED AIR. THE HAULING IS DONE WITH 1-CUBIC YARD STEEL CARS PULLED BY CABLES ATTACHED TO AIR HOISTS (FIG. 4). AS SOON AS A ROAD IS COMPLETED, OVER WHICH A POWER SHOVEL MAY BE TRANSPORTED FROM THE CAMP SITE TO THE WEST PORTAL OF THE TUNNEL, AN ERIE AIR SHOVEL WILL BEGIN ENLARGING THE PILOT TUNNEL TO THE CROSS SECTION SPECIFIED FOR THE COMPLETED MAIN TUNNEL.





## PROGRESS OF FEDERAL HIGHWAY LEGISLATION

(NOT FOR RELEASE)

NEW BILLS INTRODUCED IN CONGRESS SINCE THE LAST ISSUE OF THE NEWS LETTER AND FURTHER ACTION ON BILLS PREVIOUSLY INTRODUCED ARE SUMMARIZED AS FOLLOWS:

H.R. 5772. - INTRODUCED IN THE HOUSE ON DECEMBER 5, BY G. E. CAMPBELL OF PENNSYLVANIA, AND REPORTED OUT WITHOUT AMENDMENT BY THE COMMITTEE ON THE JUDICIARY ON JANUARY 18: PROVIDES THAT EVERY FEDERAL AGENCY, BEFORE EXPENDING ANY FUNDS FOR ANY CONSTRUCTION PROJECT, ESTIMATED TO COST MORE THAN \$25,000, AND NOT CONSTITUTING MAINTENANCE OR REPAIR, SHALL PREPARE COMPLETE PLANS AND SPECIFICATIONS FOR SUCH PROJECT, TOGETHER WITH A DETAILED ESTIMATE OF THE ENTIRE COST.

H.R. 5800. - INTRODUCED IN THE SENATE ON DECEMBER 12, AND REPORTED OUT FAVORABLY WITHOUT AMENDMENT BY THE COMMITTEE ON APPROPRIATIONS ON JANUARY 6: THIS IS THE URGENT DEFICIENCY BILL REPORTED IN THE DECEMBER NEWS LETTER.

H.R. 9767. - INTRODUCED IN THE HOUSE ON JANUARY 20, BY E. W. GIBSON OF VERMONT, AND REFERRED TO THE COMMITTEE ON ROADS: AUTHORIZES AN APPROPRIATION OF \$2,654,000 FOR THE RELIEF OF VERMONT ON ACCOUNT OF THE DAMAGE AND DESTRUCTION OF ROADS AND BRIDGES BY THE RECENT FLOOD AND PROVIDES THAT THE AUTHORIZATION SHALL BE SPENT IN ACCORDANCE WITH THE PROVISIONS OF THE FEDERAL HIGHWAY ACT, EXCEPT THAT THE \$15,000 PER MILE LIMITATION SHALL NOT APPLY, AND "THE PROVISION RESTRICTING THE EXPENDITURE OF FEDERAL FUNDS UPON ROADS ON THE SYSTEM OF FEDERAL-AID HIGHWAYS SHALL NOT APPLY TO THE EXTENT THAT SUCH EXPENDITURE IS HEREBY AUTHORIZED ON ROADS AND BRIDGES NOT ON BUT WHICH ARE EXTENSIONS OF SAID SYSTEM WITHIN MUNICIPALITIES HAVING A POPULATION OF TWO THOUSAND FIVE HUNDRED OR MORE, AS SHOWN BY THE LAST AVAILABLE CENSUS."

H.R. 9846. - INTRODUCED IN THE HOUSE ON JANUARY 23, BY R. H. CLANCY OF MICHIGAN, AND REFERRED TO THE COMMITTEE ON ROADS: PROVIDES THAT EXISTING FEDERAL-AID HIGHWAY LEGISLATION BE AMENDED BY AUTHORIZING AN APPROPRIATION OF \$100,000,000 FOR EACH OF THE FISCAL YEARS 1930, AND 1931; AND AN ADDITIONAL SUM OF \$7,500,000 FOR FOREST ROADS AND TRAILS, UNDER SECTION 23, FOR EACH OF THE FISCAL YEARS 1930, AND 1931.

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H.R. 9854. - INTRODUCED IN THE HOUSE ON JANUARY 23, BY J. M. ROBSON OF KENTUCKY, AND REFERRED TO THE COMMITTEE ON ROADS: THE PROVISIONS OF THIS BILL ARE IDENTICAL WITH THOSE OF H.R. 9846 AS REPORTED ABOVE.

H.R. 9859. - INTRODUCED IN THE HOUSE ON JANUARY 23, BY D. B. COLTON OF UTAH, AND REFERRED TO THE COMMITTEE ON ROADS: PROVIDES THAT THE EXISTING FEDERAL-AID HIGHWAY LEGISLATION BE AMENDED BY ADDING, AT THE END OF SECTION 11, A NEW PARAGRAPH, AS FOLLOWS: "IN THE CASE OF A PROJECT FOR THE CONSTRUCTION OF ANY PART OF THE SYSTEM OF PRIMARY OR INTERSTATE HIGHWAYS OF A STATE IN WHICH (1) THE UNAPPROPRIATED PUBLIC LANDS AND NON-TAXABLE INDIAN LANDS, INDIVIDUAL OR TRIBAL, EXCEED 5 PER CENTUM OF THE TOTAL AREA OF ALL LANDS IN THE STATE, AND (2) THE POPULATION, AS SHOWN BY THE LATEST AVAILABLE FEDERAL CENSUS, DOES NOT EXCEED THE RATE OF TEN PERSONS PER SQUARE MILE OF AREA, THE SECRETARY OF AGRICULTURE MAY, UPON REQUEST OF THE STATE HIGHWAY DEPARTMENT, INCREASE THE SHARE TO BE PAID BY THE UNITED STATES IN RESPECT OF SUCH PROJECT TO ANY AMOUNT (WITHIN THE AMOUNTS AVAILABLE FOR FEDERAL AID IN SUCH STATE) UP TO AND INCLUDING THE WHOLE COST THEREOF, BUT SUCH STATE SHALL EXPEND THE AMOUNT IT WOULD HAVE BEEN REQUIRED TO EXPEND UPON SUCH PROJECT IF THIS PARAGRAPH HAD NOT BEEN ENACTED UPON SUCH OTHER FEDERAL-AID PROJECT OR PROJECTS THEREIN, AND AT SUCH TIME AS THE SECRETARY OF AGRICULTURE MAY REQUIRE."

H.R. 10142. - INTRODUCED IN THE HOUSE ON JANUARY 30, BY E. E. BROWNE OF WISCONSIN, AND REFERRED TO THE COMMITTEE ON ROADS: PROVIDES THAT THE PROCEEDS FROM THE SALE OF SURPLUS WAR MATERIAL, HIGHWAY EQUIPMENT, AND SUPPLIES TO THE GOVERNMENT OF FRANCE FOR WHICH THE UNITED STATES HOLDS BONDS TOTALLING \$407,341,145, IS AUTHORIZED TO BE APPROPRIATED FOR THE CONSTRUCTION OF FEDERAL-AID AND FOREST ROADS IN ACCORDANCE WITH THE PROVISIONS OF THE EXISTING FEDERAL-AID HIGHWAY LEGISLATION. PROVIDES THAT 90 PER CENT OF THE AMOUNT SHALL BE APPORTIONED TO THE STATES FOR FEDERAL-AID ROADS AND THE REMAINING 10 PER CENT FOR FOREST ROADS. PROVIDES THAT THESE EXPENDITURES ARE EXEMPTED FROM THE EXISTING LIMITATION AS TO THE ALLOWABLE FEDERAL AID PER MILE, AND AS TO THE PER CENT ALLOTTED UPON THE PRIMARY ROADS, AND AS TO THE PER CENT OF COST TO BE BORNE BY THE FEDERAL GOVERNMENT. PROVIDES THAT THE STATE SHALL IN NO CASE PAY MORE THAN 20 PER CENT OF THE COST OF ANY HIGHWAY PROJECT, AND THAT ONLY PRIMARY OR INTERSTATE HIGHWAY PROJECTS SHALL BE BUILT, AND THAT THEY SHALL ALL BE OF THE DURABLE, HARD-SURFACED TYPE. THIS ACT IS NOT INTENDED TO REPEAL ANY PROVISION OF THE EXISTING FEDERAL-AID ROAD LEGISLATION UNLESS SUCH PROVISION IS IN DIRECT CONFLICT THEREWITH.





H.R. 10565. - INTRODUCED IN THE HOUSE ON FEBRUARY 6, BY J. M. ROBSON OF KENTUCKY, AND REFERRED TO THE COMMITTEE ON ROADS: AUTHORIZES AN APPROPRIATION OF \$1,831,794 FOR THE RELIEF OF KENTUCKY ON ACCOUNT OF THE DAMAGE AND DESTRUCTION OF ROADS AND BRIDGES BY THE RECENT FLOOD. PROVIDES THAT THE FUNDS SHALL BE SPENT UNDER THE DIRECTION OF THE BUREAU IN COOPERATION WITH THE STATE HIGHWAY DEPARTMENT; THAT THE STATE SHALL EXPEND A LIKE SUM; THAT NOT MORE THAN \$3,000 PER MILE ON ANY ROAD OR \$15,000 ON ANY BRIDGE SHALL BE SPENT FROM THESE FUNDS; THAT NONE OF THE APPROPRIATION SHALL BE SPENT FOR RIGHT OF WAY OR ENGINEERING FEES; AND, THAT NONE OF THE APPROPRIATION SHALL BE EXPENDED WITHIN AN INCORPORATED TOWN OR CITY.

H.R. 10800. - INTRODUCED IN THE HOUSE ON FEBRUARY 10, BY W. W. HASTINGS OF OKLAHOMA, AND REFERRED TO THE COMMITTEE ON ROADS: AUTHORIZES AN APPROPRIATION OF \$230,000 FOR THE RELIEF OF OKLAHOMA ON ACCOUNT OF THE DAMAGE AND DESTRUCTION OF ROADS AND BRIDGES BY THE RECENT FLOOD AND PROVIDES THAT THE AUTHORIZATION SHALL BE SPENT IN ACCORDANCE WITH THE PROVISIONS OF THE FEDERAL HIGHWAY ACT, EXCEPT THAT THE \$15,000 PER MILE LIMITATION SHALL NOT APPLY, AND "THE PROVISION RESTRICTING THE EXPENDITURE OF FEDERAL FUNDS UPON ROADS ON THE SYSTEM OF FEDERAL-AID HIGHWAYS SHALL NOT APPLY TO THE EXTENT THAT SUCH EXPENDITURE IS HEREBY AUTHORIZED ON ROADS AND BRIDGES NOT ON, BUT WHICH ARE EXTENSIONS OF SAID SYSTEM WITHIN MUNICIPALITIES HAVING A POPULATION OF TWO THOUSAND FIVE HUNDRED OR MORE, AS SHOWN BY THE LAST AVAILABLE CENSUS."

H.R. 10864. - INTRODUCED IN THE HOUSE ON FEBRUARY 13, BY F. HALE OF NEW HAMPSHIRE, AND REFERRED TO THE COMMITTEE ON ROADS: AUTHORIZES AN APPROPRIATION OF \$653,300 FOR THE RELIEF OF NEW HAMPSHIRE ON ACCOUNT OF THE DAMAGE AND DESTRUCTION OF ROADS AND BRIDGES BY THE RECENT FLOOD AND PROVIDES THAT THE AUTHORIZATION SHALL BE SPENT IN ACCORDANCE WITH THE PROVISIONS OF THE FEDERAL HIGHWAY ACT, SUBJECT TO THE SAME EXCEPTIONS GIVEN ABOVE FOR H.R. 10800.

H.R. 10879. - INTRODUCED IN THE HOUSE ON FEBRUARY 13, BY J. CRAIL OF CALIFORNIA, AND REFERRED TO THE COMMITTEE ON ROADS: AUTHORIZES AN APPROPRIATION OF \$250,000 FOR THE PREPARATION OF PLANS AND REPORTS, RELATIVE TO THE ESTABLISHMENT OF A PACIFIC COAST NATIONAL HIGHWAY SYSTEM, UNDER THE SUPERVISION OF THE SECRETARY OF WAR. ENGINEERS OF THE BUREAU OF PUBLIC ROADS MAY BE USED IN MAKING ALL NECESSARY SURVEYS UPON REQUEST AND UNDER THE DIRECTION OF THE SECRETARY OF WAR. THE SYSTEM OF MOTOR-TRUCK HIGHWAYS IS TO MEET THE REQUIREMENTS OF HEAVY COMMERCE IN TIME OF PEACE AND HEAVY ORDNANCE IN TIME OF WAR. IN GENERAL, THE PLAN CALLS FOR



THREE MAIN TRUNK LINES, WITH SUFFICIENT LATERALS, THROUGH THE STATES OF WASHINGTON, OREGON, AND CALIFORNIA. THE FIRST LINE OF DEFENSE SHALL BE KNOWN AS THE BALBOA OR COAST HIGHWAY, THE SECOND LINE OF DEFENSE AS THE PACIFIC GOLDEN STATE HIGHWAY, AND THE THIRD OR INNER LINE OF DEFENSE AS THE EL CAMINO SIERRA OR MOUNTAIN HIGHWAY.

H.RES. 103. - INTRODUCED IN THE HOUSE ON JANUARY 26, BY A. JOHNSON OF WASHINGTON, AND REFERRED TO THE COMMITTEE ON RULES: AUTHORIZES AND DIRECTS THE SPEAKER OF THE HOUSE TO APPOINT A SPECIAL COMMITTEE TO INVESTIGATE AND INQUIRE INTO ALL FACTS IN RELATION TO THE DESIGNATION OF THE EXISTING SYSTEM OF NUMBERED UNITED STATES HIGHWAYS.

H.J.RES. 107. - INTRODUCED IN THE HOUSE ON DECEMBER 16, BY J. C. LINTHICUM OF MARYLAND, AND REPORTED OUT FAVORABLY BY THE COMMITTEE ON FOREIGN AFFAIRS ON JANUARY 24: AUTHORIZES AND REQUESTS THE PRESIDENT TO EXTEND TO THE PERMANENT INTERNATIONAL ASSOCIATION OF ROAD CONGRESSES AN INVITATION TO HOLD THE SIXTH SESSION IN THE UNITED STATES, EITHER IN 1929, OR 1930. ALSO AUTHORIZES TO BE APPROPRIATED THE SUM OF \$25,000 FOR THE EXPENSES OF SUCH SESSION AS MAY NECESSARILY BE INCURRED BY THE GOVERNMENT OF THE UNITED STATES.

H.J.RES. 108. - INTRODUCED IN THE HOUSE ON DECEMBER 16, BY J. C. LINTHICUM OF MARYLAND, AND REPORTED OUT FAVORABLY BY THE COMMITTEE ON FOREIGN AFFAIRS ON JANUARY 24: AUTHORIZES AN APPROPRIATION OF \$15,000 FOR THE EXPENSES INCIDENT TO THE PARTICIPATION BY THE UNITED STATES IN THE SECOND PAN AMERICAN CONFERENCE ON HIGHWAYS TO BE HELD AT RIO DE JANEIRO.

S.1182. - INTRODUCED IN THE SENATE ON DECEMBER 6, BY C. L. McNARY OF OREGON, AND REPORTED OUT, WITHOUT ANY AMENDMENT, BY THE COMMITTEE ON AGRICULTURE AND FORESTRY, ON JANUARY 9. THIS BILL WAS REPORTED IN THE DECEMBER NEWS LETTER.

S. 2699. - INTRODUCED IN THE SENATE ON JANUARY 17, BY F. L. GREENE OF VERMONT, READ TWICE, AND REFERRED TO THE COMMITTEE ON COMMERCE. THIS BILL IS IDENTICAL WITH H.R. 9767 AS REPORTED ABOVE.

S. 3081. - INTRODUCED IN THE SENATE ON FEBRUARY 8, BY M. SHEPPARD OF TEXAS, READ TWICE, AND REFERRED TO THE COMMITTEE ON POST OFFICES AND POST ROADS: PROVIDES THAT SECTION 21 OF THE FEDERAL HIGHWAY ACT BE AMENDED AS FOLLOWS: "SO MUCH, NOT TO EXCEED ONE-FOURTH OF 1 PER CENTUM, OF ALL MONEY APPROPRIATED FOR THE FISCAL YEAR ENDING JUNE 30, 1929, AND SUBSEQUENT YEARS FOR EXPENDITURE



UNDER THE PROVISIONS OF THIS ACT, AS THE CHIEF OF ENGINEERS, WITH THE APPROVAL OF THE SECRETARY OF WAR, MAY DEEM NECESSARY FOR CARRYING ON HIGHWAY RESEARCH AND INVESTIGATIONAL STUDIES INDEPENDENTLY, AND FOR PUBLISHING THE RESULTS THEREOF, SHALL BE DEDUCTED FOR SUCH PURPOSES, AVAILABLE UNTIL EXPENDED. ANY OF THE RESULTS OF SUCH RESEARCH AND STUDIES SHALL BE AVAILABLE TO THE SECRETARY OF AGRICULTURE. THE TOTAL AMOUNT AUTHORIZED TO BE DEDUCTED BY THE PRECEDING PARAGRAPH, IN RESPECT OF ANY FISCAL YEAR, SHALL NOT EXCEED  $2\frac{1}{3}$  PER CENTUM OF THE AMOUNT APPROPRIATED FOR SUCH FISCAL YEAR FOR EXPENDITURE UNDER THE PROVISIONS OF THIS ACT, LESS THE AMOUNT DEDUCTED UNDER THIS PARAGRAPH."

S.J.RES. 30. - INTRODUCED IN THE SENATE ON DECEMBER 12, BY L. C. PHIPPS OF COLORADO, AND REPORTED OUT FAVORABLY, WITHOUT AN AMENDMENT, BY THE COMMITTEE ON FOREIGN RELATIONS, ON FEBRUARY 8. THIS BILL WAS REPORTED IN THE DECEMBER NEWS LETTER.

S.J.RES. 31. - INTRODUCED IN THE SENATE ON DECEMBER 12, BY L. C. PHIPPS OF COLORADO, AND REPORTED OUT FAVORABLY, WITHOUT AN AMENDMENT, BY THE COMMITTEE ON FOREIGN RELATIONS, ON FEBRUARY 8. THIS BILL WAS REPORTED IN THE DECEMBER NEWS LETTER.



